POWER

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Big Business—How to Keep It Beneficent

$32,000 Checks Form Evidence In Milk Plot

Dr. Harris Uncovers Supposed Payments to Alleged "Key Man" by Producer From the Middle West

Suspends Two Inspectors

Poultry Slush Fund Of $500,000 To Be Sifted by Ottinger

Attorney General Investigating Disposition of $10 Fee He Says Was Paid by Dealers on Every Car

THE HEADLINES herewith appeared on a single page of the New York *Herald Tribune* for Sunday.

The New York *Times*, last Monday morning, in announcing the death of August Thyssen, the German ironmaster, says:

> Thyssen always insisted that the secret of his success was his belief in the principle of industrial concentration and in the efficacy of trusts as factors in preventing trade crises. He was the foe of the middleman, and his principal aim was to eliminate waste and cheapen production.

The ease of communication, facility of transportation and exchange of products that we now enjoy have had a prodigious effect upon the vital processes of the nation.

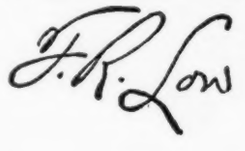
The spinning wheel and the hand loom have given place to the textile mill, the village cobbler to the shoe factory, the local butcher to the packing house, the grist mill to the great flour manufactories, the wood lot to the coal mine, and the truck and canal boat to the railroad and steamship.

And even these, through various forms of combination, have been aggregated into great organizations realizing the possibilities and economies of mass production, expert management and collective purchase and sale.

The popular apprehension of the trust is changing to an appreciation of the fact that in such concentration of means and effort, in such intelligent co-ordination and organization of interest and endeavor, rather than in expensive, disorganizing competition, lies the greatest overall efficiency, the shortest road to the best utilization of our natural resources, and the best method of applying our man power to their fabrication and use.

The public is coming to believe in the beneficent trust. All it wants is to be assured that it will remain beneficent and that the people shall share the benefits of such monopoly and aggregation.

One of the biggest questions before the publicist of today is how the industrial and commercial processes of the nation can be organized along the lines of the best efficiency without stifling individual enterprise and initiative and how they can be controlled in the interest of the consumer without developing conditions such as exist in the New York dairy and poultry trades.



Rocky Mount, N. C., Installs Modern Power Plant

The New Municipal Electric Light Plant at Rocky Mount, N. C., Uses High-Pressure Steam in Latest Design of Turbine—Modern Equipment Employed Throughout—Total Capacity of 7,500 Kw. Contemplated

THE STRICTURE of inefficient equipment so often brought against municipal central stations does not apply in respect to the new Rocky Mount, N. C., power plant, which has just been placed in service. Advances in power-plant engineering have been adopted, with the result that the character of equipment and the efficiencies expected equal those of any plant of like capacity.

The municipality has had a light plant for a number of years, equipment being added from time to time until in 1924 there were one 1,000-kw. and one 500-kw. turbines, together with two 200-kw. cross-compound nonreleasing Corliss engine-generator sets. Using steam at 125-lb. pressure, the units were not economical compared with more recent designs. In addition, the total connected load was approximately 1,900 kw. and the capacity of the plant was just able to take care of the demand. The load had been steadily increasing and more prime mover capacity would be needed in the near future.

In a study of the problem the consulting engineer constructed a curve of the yearly power demand to include the last ten years. This curve was extended to show the probable future load and approximately within four years the demand would be around 2,500 kw. The choice of action lay between the addition of a 1,500-kw. unit to the present plant and the construction of a new plant large enough to accommodate the growth for several years. Based on a strictly economical viewpoint, it seemed that the addition to the present plant was the proper solution, but the city authorities felt that this meant an investment in a unit the efficiency of which, due to low steam pressure, would entail a heavy operating loss extending far into the future. It was decided, even at the expense of a temporary increase in overhead charges per kilowatt-hour, to construct the new plant. To eliminate the necessity of enlarging the building when additional units would be needed, the plant was designed to accommodate two more boilers and two more 2,500-kw. units than are now being installed.

As will be seen from Fig. 1, the building is a brick structure and is placed at the edge of the Tar River about two miles from town and adjoining the old plant, with the boiler room between the old building and the turbine room.

The turbine, which is a 2,500-kw. 80 per cent power factor Curtis type, embraces several new features recently brought out by the maker. The valve gear is placed in a horizontal position instead of the usual vertical location. There are thirteen stages, and the

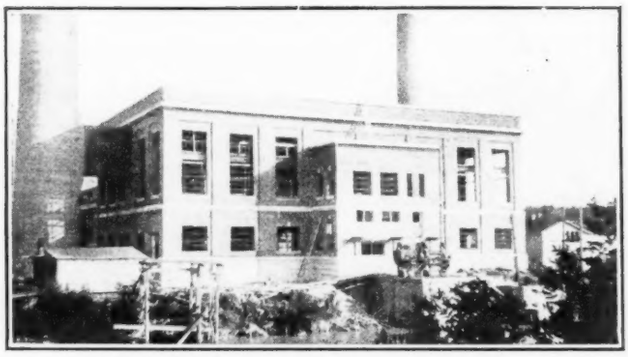


Fig. 1—View of new power house

bearings are oil cooled. The guaranteed steam consumptions per kilowatt-hour at various loads with steam at 300 lb. pressure and with 125 deg. of superheat, and with a condenser pressure of 2 in. absolute, are:

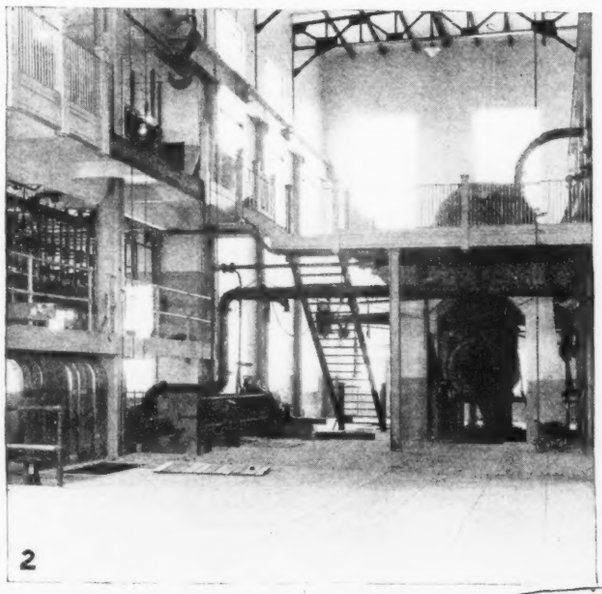
Load	Kw. Output	Steam Per Kw.-Hr.
¼	625	16.9
½	1,250	14.15
¾	1,875	13.15
Full	2,500	12.75
1¼	3,125 (100 per cent P. F.)	12.75

This includes the power losses of the exciter that is coupled to the shaft extension of the generator.

As will be observed from Figs. 2 and 3, the turbine is placed on a gallery supported by concrete pillars, with the condenser resting between the columns.

The condenser, which is of the surface type, has a total cooling surface of 5,800 sq.ft. An unusual arrangement is made in the atmospheric relief line. Instead of taking it directly off the connection at the turbine exhaust, a large gate valve, the stem of which can be seen through the staircase in Fig. 2, was placed in the exhaust line between the atmospheric connection and the condenser. If the condenser loses its water, the valve can be closed and the turbine run non-condensing without danger of cracking the condenser tubes through a rapid change of temperature. The advantage hardly outweighs the cost of the valve, and on future units the arrangement will not be followed. The 14-in. spiral-riveted galvanized atmospheric line enters the boiler-room basement and after running the entire length of the latter rises vertically to a point above the roof. The condenser is fitted with two centrifugal condensate pumps, one motor driven and the second driven by a small non-condensing turbine. The air pump is of the radiojet type and is placed at one side of the condenser.

Cooling water is obtained from the Tar River through a concrete intake channel. Traveling screens placed at the entrance remove all the large foreign substances floating in the water. The concrete duct passes under the floor of the building to the 16-in. single-stage centrifugal pumps, placed in the bay shown in the foreground in Fig. 1 and also in Fig. 2. One of the pumps is directly connected to a slip-ring motor and the



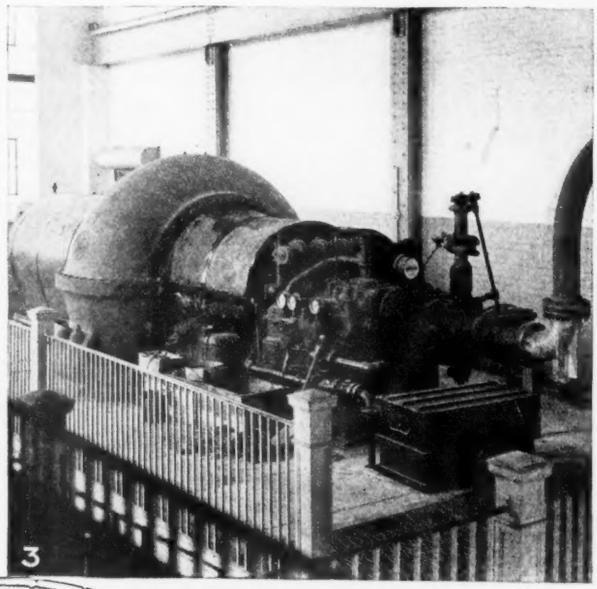
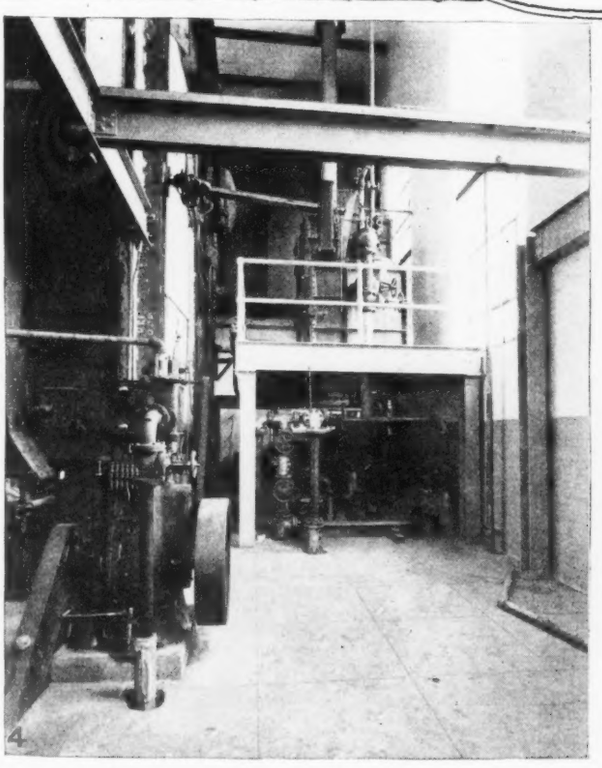


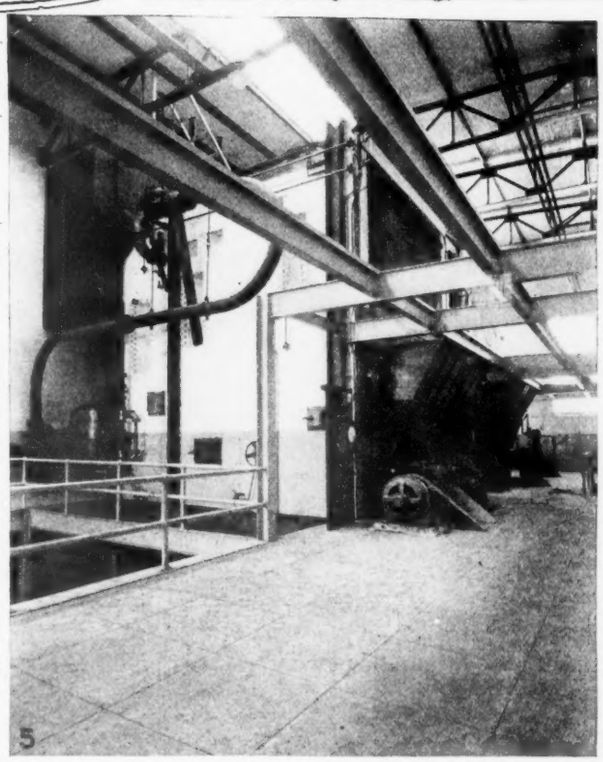
Fig. 2—The turbine is placed on a concrete entablature above the condenser

Fig. 3—Close-up of turbine

Fig. 4—The feed-water heater is in the background, with the stoker engine shown at the left

Fig. 5—Long radius bends eliminate elbows in the steam line





second is geared to a non-condensing steam turbine. The pumps deliver the cooling water to the condenser through the pipe line shown just above the condenser in Fig. 2. The discharge from the condenser is led into a second concrete flume, from which it reaches the river. The static head through which the water must be delivered is approximately 40 ft. and it is estimated that the friction losses will practically equal the siphonage advantage, making the operating head around 40 ft.

On the main floor and to one side of the turbine supports is placed a 35-kw. exciter direct connected to a non-condensing turbine. This is for emergency use, as the exciter on the main unit will normally carry the excitation load.

The switchboard is placed on a gallery above the circulating water pumps as shown in Figs. 2 and 6. The switchboard tender is able to see all parts of the turbine room from a position in front of the board. A short staircase gives access to the gallery from the turbine deck.

In the boiler room are placed two 8,780-sq.ft. cross-drum water-tube boilers. These are built for 300 lb. working pressure and are fitted with superheaters to give 125 deg. superheat, placed above the tubes. The stokers, which are of the underfeed type, are driven by silent chains from a common jackshaft that runs along the basement ceiling. On the firing aisle floor, which is approximately 8 ft. below the turbine deck, are placed a high-speed inclosed vertical steam engine and a 30-hp. motor; both drive the stoker jackshaft through silent chains. By suitable clutches either the motor or the engine may be put upon the stoker load.

The combined boiler and stoker guaranteed efficiencies are:

Lb. Steam Per Hour (Based on, from and at 212 deg. F.)	Combined Efficiency Per Cent
25,500	76
38,250	78
51,000	76
63,750	72
76,500	68

The forced-draft fans, one for each boiler, are placed in the basement of the boiler room directly under the firing isle. The air discharges through steel connections into the stoker wind boxes. To each fan is connected a variable-speed motor and a non-condensing steam turbine.

The furnace is lined with ventilated blocks, the top portion of the walls being built of No. 1 firebrick. The smoke breeching is set behind the boiler and after passing through the front of the building enters the stack.

The steam header, shown in Fig. 5 behind the boiler, is set on roller supports. It is of extra-heavy steel pipe with welded nozzles for connections to the main turbine, auxiliary units and to a line to the old power house. All the high-pressure lines are of extra-heavy lapwelded pipe, joints are Van Stone type with Monel-metal gaskets, and each flange is provided with ten high-carbon steel bolts.

The open feed-water heater is placed on a structural steel frame between the front of the building and Boiler No. 1 and is provided with a recording weir meter and a water-temperature recorder. Below the heater are placed two boiler-feed pumps; one of these is an outside, end-packed duplex steam-driven unit, and the second a four-stage centrifugal direct connected to a 75-hp. non-condensing turbine.

The coal-handling system was designed with the increased plant capacity in view. Coal is received on the railroad track alongside the bin shown in Fig. 7. A skip hoist lifts the fuel from a concrete hopper under the track and dumps it into the 500-ton steel bin. A lorry running on the overhead rails shown in Fig. 5 takes the coal from the chute under the bin and after it is weighed delivers it to the stoker hopper. No crusher is used, as the plant is to burn a mixture of bituminous slack and nut coal.

TABLE I—EQUIPMENT COST

Coal skip, etc.	[$10,436.00
500-ton bunker	11,900.00
Ash hoppers	3,450.00
Building, foundation and water screen	109,500.00
Turbo-generator, switchboard	62,500.00
Boilers	52,286.00
Boiler settings	9,625.00
Stokers	26,790.00
Soot blowers	2,039.10
Damper regulators	548.50
Superheaters	7,892.00
Stack	14,510.00
Stack foundations	7,200.00
Steam air flow meters	1,848.00
Heaters	3,243.00
Crane	4,447.00
Condensers, circulating water and condensate pumps and drives	19,245.00
Breeching	3,933.00
Feed-water regulator	623.40
Pipe valves and fittings	16,000.00
Boiler-feed pumps and drives	4,751.00
Miscellaneous, including piping, valve, pipe covering, city labor, engineers' fee, etc.	57,233.00
Total	$430,000.00
Cost per kw. capacity	172.00
Less $40,000 account building, etc., made for ultimate capacity.	
Net cost per kw. capacity	156.00

PRINCIPAL EQUIPMENT

Consulting engineer	William C. Olsen, Raleigh, N. C.
Turbine, capacity, kw.	2,500
R.p.m.	3,600
Make	Gen. Elec. Co.
Exciter	Direct connected
Exciter standby, capacity, kw.	35
Drive	3,600 r.p.m. G.E. turbine
Condenser, type	Surface
Make	C. H. Wheeler Co.
Sq. ft. of surface	5,800
Dia. tubes, in.	1
No. tubes	1,386
Air pump, type	Radiojet
Hot well pumps, type (2)	Centrifugal
Drive	No. 1. 7½-hp. 1,740 r.p.m. G. E. motor No. 2. 7½-hp. G. E. turbine
Capacity, gal. per min.	200
Size, in.	2
Condensing water pumps (2), type	Single-stage centrifugal
Size, in.	16
Head, ft.	40
Capacity, gal. per min.	7,000
Make	C. H. Wheeler
Drive	No. 1 geared to 3,600 r.p.m. turbine No. 2 direct connected to 75-hp. 220-volt slip ring G. E. motor
Boiler-feed pump, type	Steam driven duplex
Size	12x7½x15
Make	Worthington P. & M. Corp.
Boiler-feed pump, type	Four-stage centrifugal
Size	4
Capacity, gal. per min.	200
Head, lb. per sq.in.	330
Make	Worthington P. & M. Corp.
Heater, type	Open
Make	Warren-Webster Co.
Boilers (2), type	Cross-drum water tube
Sq. ft. heating surface, each	8,780
Make	Babcock & Wilcox
Steam pressure, lb.	300
Superheat deg. F.	125
Superheaters, type	Foster
Make	Power Specialty Co
Stokers, type	8 retort underfeed
Make	Riley Stoker Corp.
Drive	6x7 Sturtevant engine 30-hp. motor
Draft fans (2), make	B. F. Sturtevant
Capacity, cu.ft. per min.	36,000
Drives	62½ variable-speed G. E. motor Terry turbine
Soot blowers	Diamond Power Specialty Corp.
Ash hoppers	R. H. Beaumont Co.
Feed-water regulators	S-C Regulator Mfg. Co.
Steam meter	Bailey Meter Co.
Damper regulator	A. W. Cash Co.
Blow-off valves	Yarnall-Waring Co.
Back-pressure valve	Fisher Gov. Co.
High-pressure piping	National Valve & Mfg. Co.
Valves	Edward Valve Co. Crane Company Chapman Valve Co.
Skip hoist	Link Belt Co.
Stack, type	Brick
Size	227 ft. by 11 ft. inside
Make	Custodis Co.
Coal bin	Southern Engineering Co.
Breeching	R. D. Cole
Crane, capacity, tons	50
Make	Marris Bros.

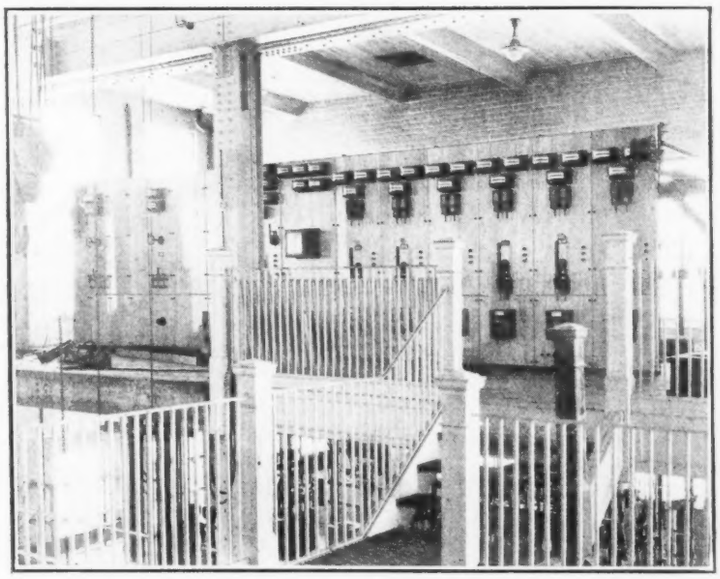


Fig. 6—View of switchboard gallery

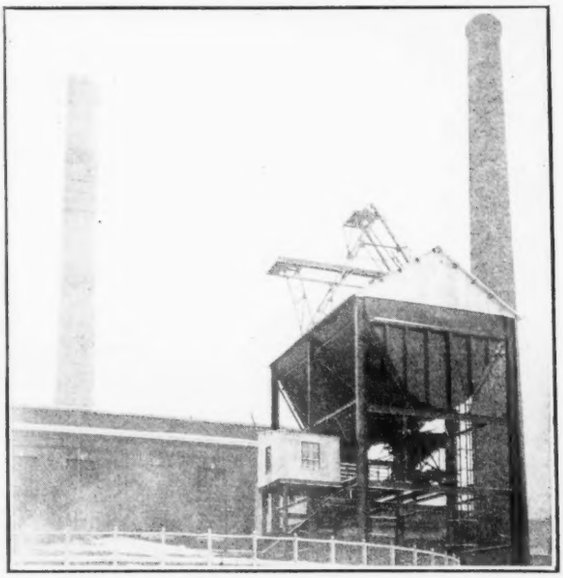


Fig. 7—Coal is stored in this steel bunker

Much of the machinery was erected by the manufacturers, the city supplying the common labor.

Whenever possible the auxiliaries have been provided with duplicate drives. In this way the most advantageous heat balance can be obtained, through control of the amount of exhaust steam going to the heater from the auxiliary steam-driving units. It is estimated that even with the present load, which is about one-half the turbine capacity, a coal rate of 2 lb. per kilowatt-hour will be obtained, making the total cost of power, including overhead charges on the plant, equal to 1.3c. per kilowatt-hour. The plant will be completed ready for test about March 1. The cost of the plant and equipment is shown in Table I.

Efficiency of Reaction Blading for Steam Turbines*

Tests conducted by Professor Stodola on a Brown-Boveri high back-pressure turbine show an efficiency reaching 80 per cent for the entire turbine and 88 per cent for the reaction portion alone. This turbine is of a combined type made up of an impulse wheel with a single row of buckets and a reaction drum of 28 stages. Every precaution was taken to reduce the leakage loss over the reaction buckets and at the shaft glands.

The capacity of the machine is 1,000 kw., and it runs at 3,000 r.p.m. The initial steam pressure is 142 lb. per square inch, and the exhaust pressure is 38 lb. per square inch gage.

The test was conducted with the utmost care, and observations were made at intermediate points in the steam flow, for the purpose of studying steam conditions during expansion. To secure consistency in the result the heat drops were calculated by means of the formulas of Knoblauch.

In summarizing the results Professor Stodola has given the following figures:

1. The engine efficiency of the entire turbine referred to the power delivered at the coupling and to the power corresponding to the adiabatic heat drop for the state of the steam at inlet and exhaust: for the total quantity of steam, 80 per cent; for the useful steam, 81.7 per cent.

2. Engine efficiency of reaction blading: for a clearance of 0.029 in., 88 per cent; extrapolated for zero clearance, 93 per cent.

The useful steam is obviously obtained from the total steam by subtracting shaft leakage and other losses. The extrapolation to zero clearance is a device for indicating the degree of perfection attained in the design of reaction blading. These results are the more remarkable because they were obtained with a turbine of relatively small power and with sufficient clearance to assure perfect security in operation.

Le Génie Civil, March 6, 1926, page 228.

THERE IS A COAL PILE in the yard of the power plant of the University of Michigan. There is another coal pile (or, to speak more exactly, several of them) at the power plants of the Detroit Edison Co. For the last twelve months a plan has been in operation that simultaneously reduces the coal consumed from both piles. This is described by O. N. Hollis, of the research department of the Detroit Edison Co., in the March issue of the *Synchroscope*. It appears that at the university plant, which was constructed about twelve years ago, steam for heating is now passed through turbines and exhausted to low-pressure mains, from which it is distributed to the buildings. The electricity generated is distributed at 2,300 volts to the buildings as far as required in them. The energy above the requirements of the buildings is put into the Edison lines. At times of light heating loads, when the amount of electricity generated is small, the additional energy required is taken from the Edison system. Before arrangements had been made to operate in this manner live steam was bled to the mains when the heating demand exceeded the university power demand. As the weather grew warmer it was necessary to exhaust some steam to the atmosphere, and during the warm months the turbines would be shut down and the Edison company would carry the entire load. The new arrangement saves coal for the Edison company in the winter and for the university in the spring and fall.

Adjusting Electric Elevator Brakes—Direct-Current Type

A Description Is Given of a Number of Different Types of Brakes Used on Elevators and How These Are Adjusted and Kept in Proper Operating Condition Is Explained

ON AN elevator machine, the brake is one of the most important parts of the equipment, for upon its proper functioning depend not only the safety but also the satisfactory operation of the machine. If the brake fails to function, control of the car may be lost by the operator, with serious results. If the brake is applied too harshly, the car will be stopped with an unpleasant jerk to the passengers and the equipment will be strained unnecessarily. When the brake is not applied with sufficient force, the car will be difficult to control and make the floor landings.

Elevator brakes have been made in about as many forms as there are types and makes of machines, so that about all that can be done in any article is to indicate a few of the different types and how they operate and are adjusted. Fig. 1 is a diagram of one of the earlier types of elevator-machine mechanically operated brakes. The two cast-iron shoes S and S' are hinged at H and attach to lever L at A. Lever L is attached to a second lever B that is raised and lowered by a cam C on the shipper wheel, the latter not being shown. When the shipper wheel is turned to either running position by the operator pulling the hand rope in the car, the left-hand end of lever B is raised and with it lever

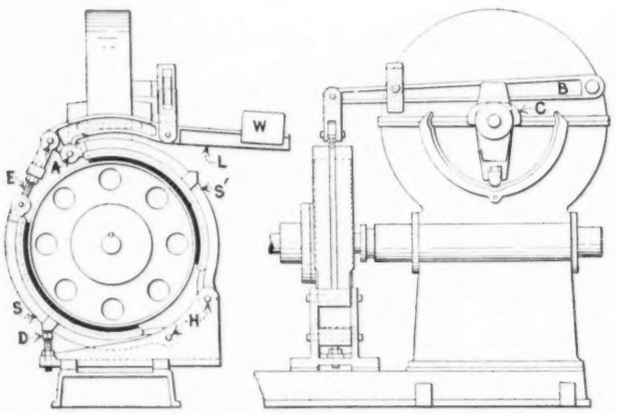


Fig. 1—Mechanically operated brake

L. This allows shoe S to drop away from the brake wheel until it is brought to rest on stop D, after which shoe S' is lifted by a further upward movement of lever L. The application of the brake is the reverse of this process, and the force with which the brake is applied is controlled by the position of the weight W.

In general it may be said that a brake should be adjusted so that the shoes just clear the wheel. However, where the brake is operated mechanically, it may be necessary to adjust it to open considerably more than this so that it will not be applied before the power is cut out of the motor. In adjusting the brake, Fig. 1, the screw D is put in a position that will let the brake shoe S drop clear of the wheel and screw E is then adjusted so that shoe S' will clear the wheel by the same amount as shoe S when the operating mechanism is in the full-on position. After this has been done, the operating mechanism should then be pulled slowly to the off position and a check made on the controller to

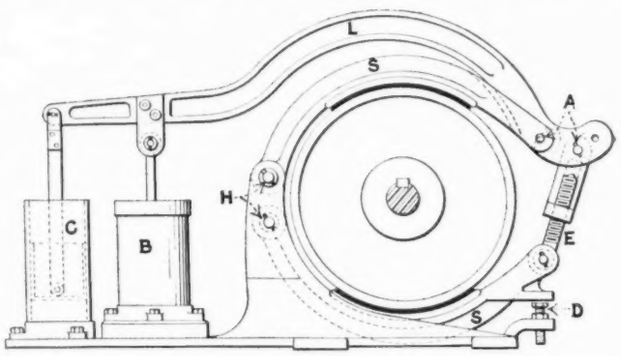


Fig. 2—Modification of the brake, Fig. 1, arranged for electrical operation

see that the brake cannot be applied hard while the motor is still connected to the line. If such a condition exists, it will be necessary to give both brake shoes more clearance from the wheel. After the brake shoes have been properly adjusted, the weight W is moved to a position that will stop the car within the desired distance.

On some of the older types of machines the starting resistance could be cut into circuit before the power was cut out of the motor. In such a case, if the brake was applied before the motor was disconnected from the line, it would be possible to stop the motor with the resistance in series and connected to the power supply, in which case the starting resistance will be overheated. In one case in mind, the operator left the elevator stopped this way when he left the building on Saturday noon, and when he returned Monday morning found everything combustible on the motor and controller burned up, even to the wood terminal blocks. Probably the only thing that saved the building was that the equipment was installed in a fireproof room. Such occurrences were not uncommon with some of the old types of mechanically operated machines. If the brake can be applied before the power is cut out of the motor, the fuses are likely to be blown, if the resistance is not cut into the motor circuit. If the fuses do not blow, breaking the heavy current on the controller contacts will cause serious burning on these parts. Improper brake adjustment, especially on some of the older types

of machine, was not infrequently the cause of considerable controller trouble.

Instead of using cast-iron shoes lined with leather as in Fig. 1, some of the older types of brakes consisted of a steel band lined with leather. The two ends of the band were connected to the brake lever in a manner similar to that shown in the figure, and the center of the band was made fast so that the brake would be opened from both ends. One of the difficulties with a band brake is to get it to clear the wheel at all points when released, due in a large part to the band not bending to a true circle about the wheel.

A somewhat similar type of brake to that in Fig. 1 is shown in Fig. 2, except that it is solenoid operated. The shoes adjusting screws and lever are lettered as in Fig. 1. The lever is brought back over the brake wheel and is connected to a solenoid *B* and an air dashpot *C*.

The solenoid is energized from contacts on the controller. Energizing of the coil causes it to pull up its core and lift the lever, thus clearing the brake shoes from the wheel. The force with which the brake is applied is controlled by the dashpot. After the brake shoes have been adjusted so that both just clear the wheel when solenoid *B* has pulled up its core, the dashpot should be adjusted to allow the brake to be applied easily. The correct adjustment of the dashpot can be determined by starting and stopping the car. This type of brake, if the shoes are given too much clearance from the wheel, may allow the lever to drop so far that the dashpot will bottom before the brake is applied, in which case it will be difficult to stop the car. It may also be possible that the core in the solenoid will drop down so far that the coil cannot

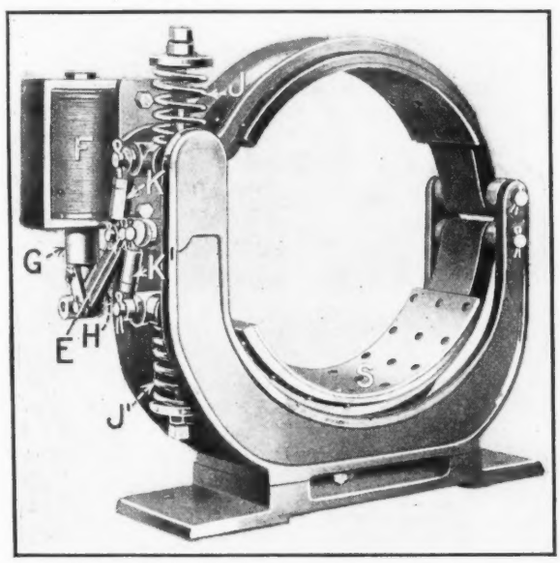


Fig. 3—Modern type of electrically operated brake

develop pull sufficient to release the brake. For this reason care should be exercised to get the brake properly adjusted. With a magnet-operated brake, the contacts on the controller, that make and break the coil circuit, must be kept adjusted so that they will always break the circuit when the power is cut out of the motor and make the circuit when the motor is connected.

On the two brakes discussed the lever has no fixed fulcrum, therefore the brake shoes cannot be adjusted so that one shoe is applied harder than the other, although one shoe may be released or applied ahead of the other. With the type of brake shown in Fig. 3, the brake lever *H* has a fixed fulcrum pin *E*, about which the lever moves up and down. In this brake the leather-lined shoes *S* are applied with springs *J* instead of a weight. Each shoe is attached to the lever *H* by turnbuckles *K* and *K'* and the long arm of the lever is attached to the core *G* of the solenoid *F*. When coil *F* is energized, it pulls up its core and the brake lever. In so doing turnbuckle *K* is pushed up and with it the top brake shoe against the tension of spring *J*. Likewise, turnbuckle *K'* and the bottom brake shoe are pushed down against the tension of the spring *J'*, thus lifting the shoes clear of the wheel. When the coil circuit is

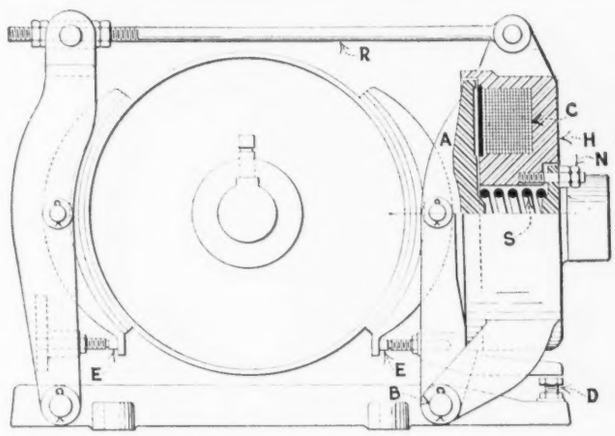


Fig. 4—Shows general arrangement of the parts of the brake, Fig. 5

opened, the core and lever are released and the brake shoes are applied by the springs, assisted by the weight of the solenoid core on the end of the lever.

In adjusting the type of brake, Fig. 3, it is essential that both shoes clear the wheel equally so that they will be applied with equal force to the wheel. If turnbuckle *K'* is made considerably longer than *K*, it may be possible to have the top shoe applied hard on the wheel and the bottom shoes not touching. After the top shoe has set on the wheel turnbuckle *K* would stop further motions of the lever and the turnbuckle would then hold the lower shoe away from the wheel. It is easy enough to adjust the shoe to the same clearance, simply by blocking the end of the lever up into the release position and then turning the turnbuckles to obtain the desired clearance for each shoe.

Equal clearance of the brake shoes does not necessarily give the best stopping of the car, although it is the best starting point in the final adjustment. The type of brake, amount of counterweight and average loading of the car, and dynamic-braking action of the motor all have an influence. With the type of brake in Fig. 3, where one shoe can be applied harder than the other, it may be found that the car will stop more quickly in one direction than in the other. In extreme cases, the car may stop with a decided jar in one direction and slide in the other. This is an indication that one brake shoe is being applied harder than the other; which one can be determined by inspection or a little experimenting. First try setting one shoe a little close to the wheel and operate the car again. If this adjustment improves the setting, it is known that the adjust-

ment is being made in the proper direction. If the stopping is not improved or is made worse, the wrong shoe is being adjusted. After the brake has been once properly adjusted, any adjustment for wear should be made equal on each shoe by marking the turnbuckles and turn each an equal amount.

In Figs. 4 and 5 is shown a Cutler-Hammer brake for use on direct-circuit elevators and cranes. The arrangement of parts is such that the operating magnet acts directly on the brake shoes. Coil *C* is in a movable housing *H*, which is hinged at *B* and is attached to the shoe on the opposite side of the brake wheel by the rod *R*. The other brake shoe is connected directly to armature *A* of the magnet. When the coil is energized, the

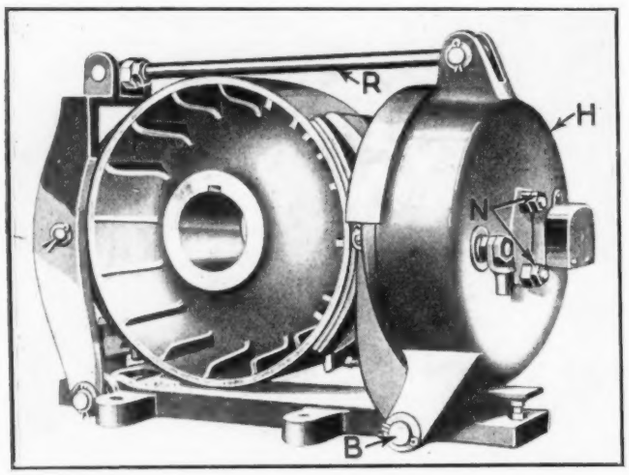


Fig. 5—Brake magnet acts directly on the brake shoes

armature is attracted to the magnet, but its motion is limited by the screw *D*, after which the magnet is pulled to the armature and releases the shoe on the opposite side of the wheel. When the coil circuit is opened, the brake is applied by the spring *S*, located in the center of the magnet, and forces the armature and magnet apart.

As all parts of the brake are acted upon by the same force, each shoe will be applied with equal effort to the wheel. One of the features of the design is the absence of toggles, bell cranks or levers to transmit the motion of the magnet's core to the brake shoes. Another feature is the small amount of motion of the magnet's armature, which is from $\frac{1}{16}$ to $\frac{1}{8}$ in. to lift the brake shoes clear of the wheel. This short movement of the magnet's armature results in an almost instantaneous application or release of the brake and also tends to prevent any bouncing or hammer blow action of the brake.

In adjusting the brake, the intensity of the force with which the shoes are applied to the wheels is obtained by taking up or on releasing the nuts *N*, Figs. 4 and 5, which act directly on the heavy spiral spring at the center of the magnet. The amount of clearance between the brake shoes and the wheel is controlled by adjusting the length of rod *R*, by the nuts on its left-hand end. Lengthening the rod increases the clearance and shortening has the opposite effect. This adjustment should be made such that the shoes will just clear the wheel when the brake is released. Screws *E* are used to adjust the shoes so that their top ends will not fall over and ride on the wheel when the brake is released. Adjusting screw *D* up or down, as the case may require, equalizes the clearance of the two shoes on the wheel.

The brake shown in Fig. 6 is one type used by the Otis Elevator Co. and is one that has a small movement of the various parts during operation. A single magnet coil *E* with a double core *D* and *D'* is used for releasing the brake, and the shoes are applied to the wheel with spiral springs *S*. The brake levers are fulcrumed at *F* and the shoes are attached at *A*. When the coil *E* is energized, it pulls the two cores *D* and *D'* together and in doing so lifts the shoes off the brake wheel. The shoes being hinged at their middle and lifted away from the wheel at the horizontal diameter by the levers, they are lifted an equal distance from the wheel at all points, which is not true of some type of brakes that have the shoes hinged at one end. The lifting of the shoes equally at all points on their periphery allows for a minimum movement when releasing and applying the brake.

The movement of cores *D* is adjusted on the screws *E* until, when the inner ends of the cores are in contact, the brake shoes just clear the wheel. Then screws *H* are adjusted to insure equal movement of each brake shoe. These are adjusted so that they will be about touching the stops at *H'* when the brake is released and the shoes are an equal distance from the wheel. The amount of pressure that the brake applies to the wheel is obtained by adjusting the spiral springs *S*. This tension should be such as to stop the car without any undue jar to the passengers. In this type of brake one shoe is applied independently of the other; therefore the springs should have equal tension. This can be determined with

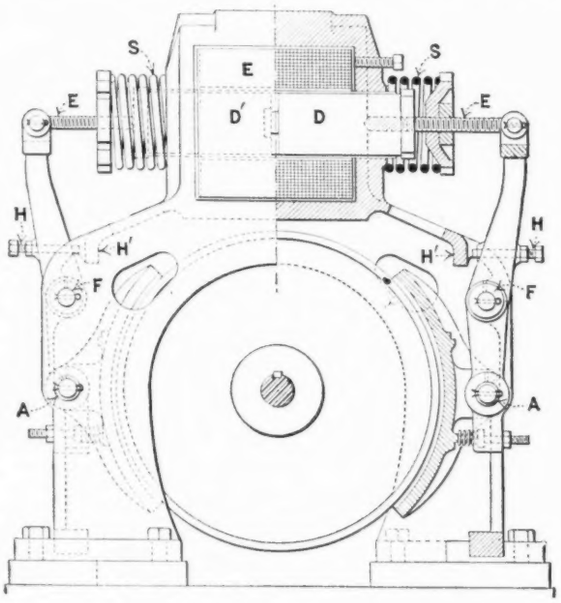


Fig. 6—Brake for use on one of the earlier types of high-speed elevators

sufficient accuracy by measuring the length of each spring, and they should be of equal length.

As previously mentioned, adjustments are made by screwing the stems *E* in and out of the cores *D* and *D'*, so that when the cores are pulled together the brake shoes will be lifted clear of the wheel. As the lining of the shoes wear, the stems *E* should be backed out of cores *D* and *D'* periodically to maintain this adjustment. If such an adjustment is maintained until lining of the

shoes is worn to where it must be renewed, when the lining is put into the shoes, it will probably be found that with the old adjustment, the cores D and D' will touch when the brake shoes are in contact with the wheel. To correct this condition the stems should be screwed into the cores to separate the latter enough to give sufficient movement to lift the shoes clear of the wheel. In adjusting the brake, care must be exercised not to separate cores too far, or the coil may not develop sufficient pull to lift the shoes from the wheel.

On the brake, Fig. 7, built by the Neenan Elevator Corporation, the left-hand shoe is connected to the right-hand core in coil C, and the right-hand shoe is connected

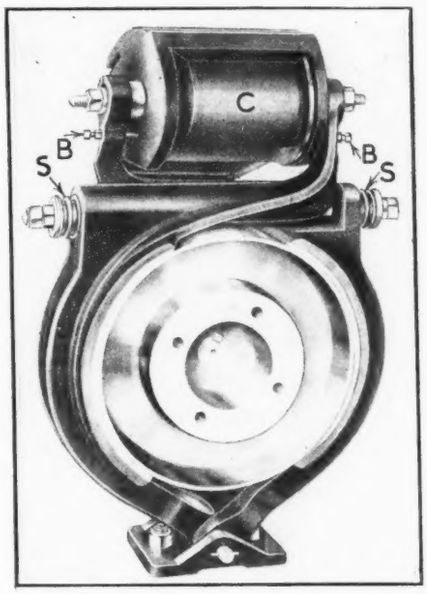


Fig. 7—Brake coil mounted between the two top ends of the brake shoes

to the left-hand core. With this arrangement, when the cores are pulled together by the coil, the brake is released by a direct pull on the shoes. This method of connecting up the brake shoes to the magnet cores allows mounting the brake shoes directly on the machine frame. The magnet cores are adjusted so that when they are together the shoes will be just clear of the wheel, and the necessary pressure on the wheel is obtained by the tension springs S. As the rod on which the springs are supported is continuous, any adjustment made on one spring affects both shoes alike. Bolts B are used to obtain equal clearance for each shoe as was explained in Fig. 6.

The brake Fig. 8 is mechanically operated, but is applied electrically in case of failure of the power supply. The brake lever L is connected to the shipper wheel S by the adjustable rod R. Coil C is connected directly across the power line. As long as the line is alive, coil C will be energized and will hold armature A in the position shown. The extension A' is part of armature A, and B is an extension of the lever carrying weight W. From this arrangement it can be seen that as long as armature A is held to the coil, weight W will be held in the position shown.

Under normal operation the brake is released and applied by the movement of skipper wheel S raising and lowering lever L. The tension with which the brake is applied is controlled by spring D, as well as by the position of weight W' and the adjustment of the screws E. If the power fails, coils C will release armature A and weight W will fall and apply the brake, and it cannot be released by the mechanical operating mechanism until weight W is raised and held in its off position. This prevents the operator from leaving the brake released on the machine with the power off the motor. On this type of brake, one brake shoe can be applied harder than the other if not properly adjusted, therefore careful attention should be given to this feature when making adjustments.

Before a brake can be expected to work properly the surface of its linings must be in good condition. There are three common materials used to line brake shoes—namely, leather, asbestos and wood—and the preference for these materials is about in the order named. The surface of the linings should be kept free of oil and dirt. Oil may work out along the worm shaft from the gear case and get on the brake wheel. When this occurs, the shoes should be removed and the oil and dirt scraped off with glass or washed off with gasoline. Applications of fullers earth may be made to absorb the oil, after which it can be scraped to leave the surface of the lining clean. Leather brake linings sometimes become dry and hard, in which case they should be treated with a good leather dressing on neatsfoot oil.

In adjusting a brake the electrical features cannot be overlooked. In most modern direct-current elevator controllers, the armature of the motor after being disconnected from the line is connected through a resistance. This causes the motor to act as a generator and offer a retarding effect on the motion of the machine, or, as it is called, dynamic braking. To insure satis-

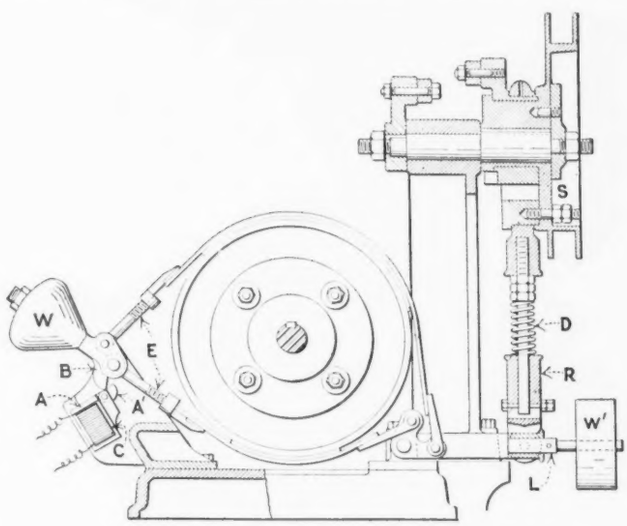


Fig. 8—Combination mechanically and electrically operated brake

factory stopping the resistance of this circuit must be of a correct value, but this is generally properly adjusted when the installation is put into service and requires no further attention except in case of short-circuits or open-circuit in the dynamic-breaking resistance. On high-speed elevators, connection schemes are used in the brake circuit to accommodate the braking action to the different speed and loadings of the car at the time of stopping. However, these are part of the control equipment and will not be discussed here.

Carbon Dioxide Refrigeration for Public Buildings

By L. T. AVERY*

Carbon dioxide refrigerating machines have been in common use for many years, both in the United States and in foreign countries. Within the past few years their use has increased very rapidly, especially in public buildings. Many engineers familiar with the principles of refrigeration in general have not had an opportunity to study carbon dioxide refrigerating equipment, and it is the purpose of this article to point out a few of the more salient characteristics.

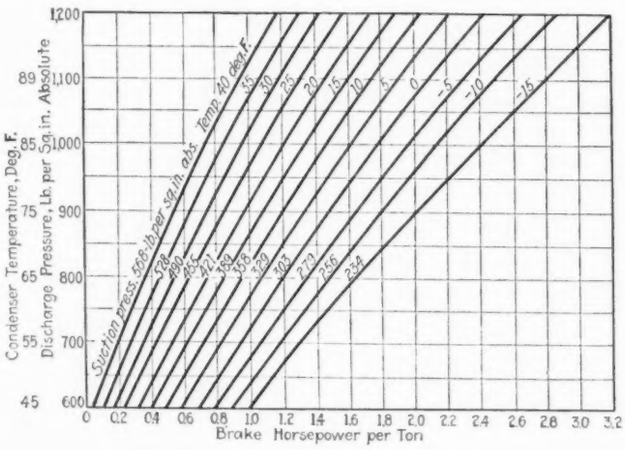
THE PRIMARY ADVANTAGE claimed for carbon dioxide is safety, as the gas is practically odorless, unless flavored with wintergreen or peppermint, and it will not support combustion nor will it explode. The properties of this refrigerant are so well known that it is not necessary here to develop these in detail. In public buildings the safety of employees and the public is of paramount importance, and by using carbon dioxide the possibility of injury from a poisonous or explosive gas is eliminated.

The opposition to carbon dioxide equipment in the past has been based on two assumptions: first, that the power required per ton of refrigeration was higher than with other refrigerants, and second, that because of the pressures used in the system, a large quantity of gas necessarily would leak out. These two obstacles have diminished in importance as improvements in the design of these machines have been made.

Referring to comparative curves for power, prepared by H. J. MacIntire, and published in *Power* Feb. 20, 1923, and herewith reproduced, with the addition of condenser temperature scales, it will be noted that with warm condensing water temperatures, say, above 80 deg., there is apparently a greater amount of power required for the carbon dioxide plant, amounting in some cases to 20 per cent. The point to consider here is how much of the total power used in the building will be charged to the refrigerating compressor and what portion of the year's time will these high condensing water temperatures prevail.

Going to the other extreme of condensing water temperatures, it will be noted that with 45 deg. condensing water the carbon dioxide compressor requires 10 per cent less power than the ammonia compressor and in northern latitudes temperatures of condensing water of 38 to 40 deg. F. are common during the winter months. The correct method of determining the relative power cost is on an annual basis and if the tables are consulted for the varying power input requirements for the changing condensing water temperatures between winter and hottest summer months, it will be found that the average annual extra power input for the same tonnage output will be only a very few per cent, if any, for the carbon dioxide compressor. When it is further considered that brine pumps, drinking water pumps and other auxiliary apparatus use a large part of the total power required for the refrigerating plant, the possible difference in cost of power for a carbon dioxide refrigerating plant is so slight that it need not be given serious consideration.

In public buildings, such as hotels, hospitals, apartments and the like, the refrigerating load is a year-around load as compared with strictly ice-making plants. For this reason the carbon dioxide equipment is particularly well adapted for public building work, as the difference in cost of a few cents per ton of refrigeration does not have the importance it would have in ordinary ice making, where the most important consideration is making ice at the lowest possible price per ton, with a very decided peak load in the summer months. When it is further considered that in public buildings the total power used by the building for elevators, ventilating equipment and other apparatus is often greater than the power used for the refrigerating plant, the conclusion is reached that the question of relative power cost between one system and another is of negligible importance.



Power used by carbon dioxide compressors

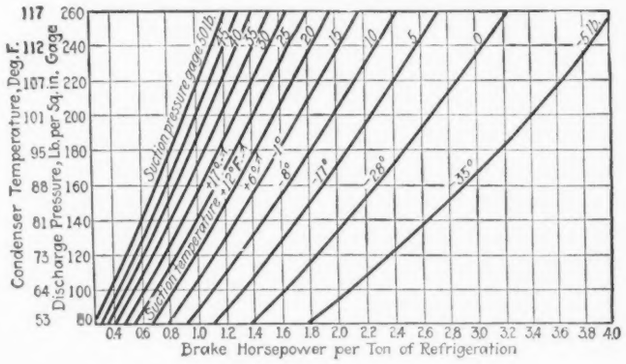
Many manufacturers of carbon dioxide systems have widely adopted the use of welding in making condensers and piping to minimize the number of joints. This has resulted in greatly reducing the possibility of leaks, so that with a gas cost of 7c. per pound for carbon dioxide, the cost per year for refrigerant with a properly operated plant should be no greater and probably would be less than with any other refrigerating gas. Carbon dioxide is readily obtained from drug store and soda water supply houses and can be purchased dry for refrigerating purposes and flavored with wintergreen, peppermint or lemon for those who prefer to have an odored gas.

Oil is readily trapped from the gas, as there is little

*American Carbonic Machinery Co., Cleveland, Ohio.

affinity between carbon dioxide and oil. This allows the system to operate with practically clean surfaces at all times, and the efficiency of the heat-transferring surfaces remains constant over a period of years.

As it is impossible to draw air into the system and as carbon dioxide will not decompose, no false pressures are created in the system and it is unnecessary to purge or trap out those foreign gases common in the operation with other refrigerants. This naturally allows the power input per ton of refrigeration to remain



Power required by ammonia machines

constant, as shown in the tables, whereas the developing of false gases with the attendant higher condensing pressures requires greater power input in ammonia systems. In many ammonia plants proper care is not taken to keep the system purged and clean, with the result that the power may increase 10 to 30 per cent without any serious thought being given to it. Many devices have been used, with varying success, for trapping out and purging ammonia condensers, but in plants of moderate size it still seems to be common practice either to let the false gases accumulate or at best to blow them off with ammonia from the bottom or top of the condenser, as the case may be.

As carbon dioxide is perfectly harmless, the operator can adjust and maintain his equipment with the minimum of effort. If the compressor needs valves reground or piston rings examined, this can be done without hurry and when convenient. The result is that the compressor will be kept in good working order and at maximum efficiency year after year. Winter overhauling of compressors is practically unknown, and the few adjustments and repairs necessary are taken care of as soon as they are noticed. The gages on the system show if valves are operating properly, if the packing is holding and if the proper charge of gas is being used; the operator, therefore, can note quickly any change in the operating characteristics of the plant.

Shut-off or bypass valves are not operated in starting or stopping the compressor. The pumping down process common with other refrigerating plants is unnecessary and the expansion valve may be set and left for proper operation without further attention. This means that the time required to stop and start the plant is a minimum and the hazard of closing the wrong valve at the wrong time is eliminated. This also allows the power used by the prime mover to be applied immediately to producing refrigeration, and there is none wasted in running the plant to get proper pressures in starting up and to remove the liquid from the expansion coils in shutting down.

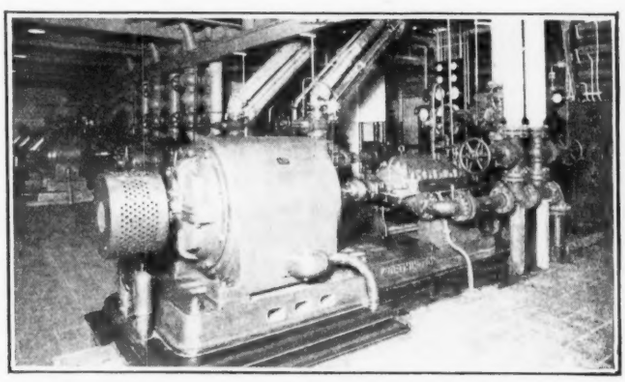
Condensing water is used in any refrigerating system and the quantity depends on the number of degrees heat rise desired between the incoming and outgoing temperatures, so that this would be practically the same for any type of apparatus. The condensing pressure depends on the mean condensing water temperature, so that the niggardly use of condensing water simply increases the power requirements, and condensing water is cheaper than electric current.

Besides the important advantages of safety, the carbon dioxide equipment has other good characteristics, and, all variables considered, the compressor will compare favorably with the ammonia compressor in operating cost. These are a few of the reasons for the increased favor toward the carbon dioxide refrigerating system shown by engineers and owners for installation in public and semi-public buildings.

Boiler-Feed Pump Operates Against 1,325 Lb.

THE high-pressure unit at the Edgar (Weymouth) station of the Edison Electric Illuminating Company of Boston necessitated the development of the highest pressure boiler-feed pump ever built. This operates at a discharge pressure of 1,325 lb. per square inch and handles 150,000 lb. of water per hour at 250 deg. F. It is a Worthington, 3-in., eight-stage double-case turbine type, driven by a variable-speed slip-ring motor of special design.

The stresses due to the high pressure are handled by using two casings, one inside the other, giving in effect a two-stage distribution of stresses. The outer shell is



The pump has eight stages and a double casing

of cast steel, horizontally split. The inner shell consists of diffusion vanes suitably constructed to perform the function of diffusion and also to act as the inner casing.

The diffusion rings are of bronze vertically split at each stage and connected one to the other through suitable fittings. The individual stage pressures acting on the diffusers hold the sections tight against leakage without the use of bolts. The sum of all the thrust due to stage pressure acts on the first ring and amounts to approximately fifty tons.

To seal the inner casing from the outer, a specially constructed lead bull ring on a cone joint is inserted at the end of the seventh stage. This bull ring is also held tight by water pressure.

Between the outside of the diffusers or inner casing and the casing proper is a clearance space filled with

water under suction pressure. The outer casing, with the exception of the last stage, is subjected only to the stresses incident to this pressure. The last stage is subjected to the full pressure of 1,325 lb.

This construction, therefore, gives a variable stress on the inner casing, depending on the particular stage and is maximum at the seventh stage only. The last stage, being made of small exposed area, notwithstanding the high pressure, does not have a stress greater than the average stress of the remainder of the casing.

This pump has a single suction impeller hydraulically balanced with an auxiliary mechanical thrust arranged in the outboard pump bearing. The hydraulic balancing function is divided into three steps. The drum section of the disk carries about 90 per cent of the total thrust and the radial element carries the remainder. In addition there is a back pressure artificially created by means of a choke in the return line, which back pressure must also be counterbalanced by the balance disk.

The shaft is of heavy type for the high speed involved and is supported by two water-cooled babbitt-lined bearings of the ring-oiling type. A flexible coupling of the metal disk type, which allows of free endwise motion during rotation, is employed to permit of free balancing-disk action without interference from other causes.

The Joys of Operating a Stand-by Plant—IV*

By "THE CHIEF"

IN A PLANT that has been shut down for several weeks or months about everything has been done that there is to do. Time sometimes hangs heavily, and you don't know just what to do. You have read last week's copy of *Power* through several times, "ads" and all, and you have wished so often for the river to go down, so that you could start up and carry load, that you are weary of wishing it and as a last resort start reading *Power* again.

Just then the door opens and in blows one of those dispensers of sunshine and radiance in the shape of a supply man. You can take it from me that those boys spread more cheer and good will than almost any other class of men I know. To me they are as welcome as the flowers in May; they always come in with a good word for everyone, hand out a few jokes, always give some good information, talk shop a little and pass along a catalog or pamphlet. If they come from the big town (which many of them do) they tell about some of your friends there, and the old Bowery, etc. (which I've not seen for many moons), pick up their brief cases and are on their way, having broken up what threatened to be a long dreary afternoon in the old stand-by.

One of the bad features of operating a stand-by plant is poor economy. One day you are running loaded to the ears—the next the bottom has dropped out and you are lucky if you get a chance to burn down the fires. When you are running because of trouble in some other steam station it's not so bad, for they let you know about when they will be able to pick up the load and you can be governed accordingly. With the water plants it's different—when the water comes up they grab the load, so as not to spill any water over the dams. They don't know any thing about boilers or fires, which mean nothing in their young lives. They know that they have water, and that's enough for them, so away goes the load—if you don't like it you can take a little run and jump up in the air.

Of course you can raise your own speed, but you don't dare do that; the factories would set up a howl that would be heard in the main office and the manager would do a shimmy around your neck. Even though you did raise the speed to pull the load back, the hydraulics would go you one better and raise theirs again. If would just be a case of "up again, down again, Finnegan" and the steam plant would be the goat with a capital G. The only thing to do is to grin and bear it, or take it out in cussing, according to your mood or religious training. The efficiency for that run is knocked into a cocked hat and the old stand-by has another black eye to its credit, and no fault of its own.

When a fellow has worked around power stations for twenty or thirty years, he is apt to be filled up with efficiency, and that's my case. I have been fed up on it since I could walk—had it drummed into me morning, noon and night, seven days a week every week in the year—ate it, drank it and was never out of its sight all these years. I have been feeding others the same dose (or trying to) for several years. So when you get a deal like these water-power stations hand you, it gets under your skin and you would like to get even, but they've got you, and you might as well be a good sport and take it—but it hurts, brother, it hurts. The steam plant is in the city, and they (the water plant) are away off in the woods somewhere where they don't have to hear any of the factories kick, and if they did I think they would imagine it was someone asking them to pick up more load.

Every cloud has a silver lining, and sooner or later there is a day of reckoning. The waterwheels or racks or gates get stopped up with ice or trash; then they crawl and want you to be a good fellow and get on the line as quickly as you can and help them out of a hole. The old stand-by is on in a jiff, and away goes your friend up the river leaving you to get along as best you can. By the time the fires are built up, the trash or ice has been got rid of and friend W. P. P. comes in with a smile, grabs the load, and there you are with several nice fires and nowhere to go.

It's quite a temptation to break a leg or do something to dump them when they holler for help, but if we did we'd be the goat anyway, so I guess we will continue to get in as quickly as we can. Besides, their water will be shot before long and they will be out of the way for some time. Then they will be praying for rain the same as we sometimes pray for sunshine.

(To be continued)

*The Preceding installments appeared in the issues of March 16, March 30 and April 6.

WATER FOR COOLING THE DIESEL ENGINE, although ordinarily a minor item of expense, is a matter of importance. Any water suitable for boiler feed will be suitable for jacket cooling, but the reverse is not always true, and in the latter case difficulty with hard water may be avoided by keeping the final temperature below the point at which the impurities precipitate, and the water may be cooled for re-use by any of the usual means. Preferably, initial temperature should not be over 50 deg. F. and discharge temperature may range from 110 to 125 deg. for hard water or up to 150 deg. for soft water.

Operating Schedules and Their Use in Hydro-Electric Plants

Methods Employed in Working Out an Operating Schedule That Has Been Adopted in a Large Hydro-Electric Plant Are Explained—This Schedule Has Been Applied to Good Advantage in the Operation of the Station

By PAUL F. KRUSE*

IN MODERN hydro-electric stations it is becoming quite general practice to supply the operators with a schedule to show the loading of the units that will give the highest plant efficiency. With the interconnected hydro-electric and steam-electric generating stations a definite plan or operating schedule for directing the distribution of the load is of even greater importance than when the plants are operated independently.

In the School Street station of the Cohoes Power & Light Corporation at Cohoes, N. Y., there are five hydro-electric generating units. The turbines of four of these units are rated at 10,000 hp. under 96-ft. net head, and the fifth turbine has a rated capacity of 16,000 hp. The recent installation of the fifth unit and its relation to the rest of the station was described in the March 9 issue of *Power*. A description of an operating schedule developed and put into service for operating the units in this station based on the performance data obtained by efficiency tests of the units in place follows:

In the case of the older units Nos. 1 to 4, the data obtained in field tests by the Gibson method, made in 1923, were used. In the field acceptance test of Unit No. 5 made in February, 1925, the Gibson method was again used for measuring the discharge of the turbine at various loads. For the electrical measurements of output of the generator, special test instruments were obtained from the General Electric Co. As developed by this field test and as shown in Fig. 1, No. 5 turbine has a maximum efficiency of 92.5 per cent at a load of approximately 14,300 hp. As described in the previous article, this machine was installed in a setting intended originally for a 10,000-hp. unit, similar to units Nos. 1 to 4; but with a larger and more efficient waterwheel and a modified form of draft tube, the maximum capacity of the turbine when operating under a 96-ft. net head is 16,950 horsepower.

The Gibson method of measuring the flow of water in closed conduits employs special apparatus for obtaining pressure-time diagrams by photographing, through a mercury column connected to the penstock, the changes of pressure that take place in the conduit when the gates of the turbine are gradually closed. From a measurement of these diagrams and the physical measurements of the conduit, the rate of discharge prior to the closing of the turbine gates may be computed. Reference is made to a full description of this method in a paper by Norman R. Gibson, its inventor, and published in the 1923 *Proceedings* of the A.S.M.E., an abstract of which appeared in *Power*, Dec. 25, 1923.

*With Sanderson & Porter, New York City.

Two different applications of the Gibson method were employed in the tests of unit No. 5. First, the simple diagram application, in which a single connection at the lower end of the penstock was made. Second, the differential diagram application, in which the differential pressure change between two points of connection to the penstock was obtained. These two forms involve different pipe line and apparatus constants, and the results obtained with the one served as a check upon the other. The proximity of the individual test points

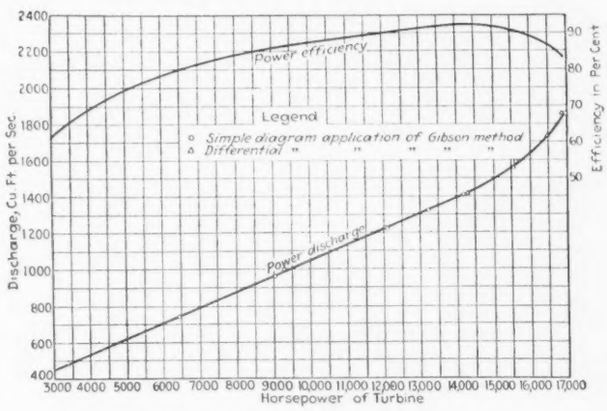


Fig. 1—Power-discharge and efficiency curves for unit No. 5

to the mean power discharge line as shown in Fig. 1 is an indication of the high degree of accuracy to be obtained with this method.

In the comparison of the performance curves for unit No. 5 with those of units Nos. 1 to 4, obtained in previous tests referred to in the foregoing, the plan shown in Fig. 5 was developed and put into use for operating the plant, with a view to obtaining the most efficient utilization of the water discharged through the station. The performance curves obtained for three of the smaller units, which were in equally good operating condition, were practically identical, and the actual test points for these units were used in drawing a mean power discharge curve that was considered to represent the normal operating condition of units Nos. 1 to 4.

Fig. 2 shows the relation among the kilowatt output of the generators, discharge of the turbines in cubic feet per second and plant efficiency from forebay to switchboard, including losses of head in the penstock and draft tube, for units Nos. 1 to 4 and unit No. 5. These curves show that the over-all plant efficiency of units Nos. 1 to 4 is 84 per cent and of No. 5 unit 87 per cent. These are the curves on which the operating schedule is based.

Fig. 4 shows the relation between the kilowatt output of the generators and the discharge of the turbines in cubic feet per second, also the kilowatts generated per second-foot at different discharges of the turbines and the power increment in kilowatts per increment of water, or the $\frac{\Delta Kw.}{\Delta Cu.ft.\text{-}sec.}$.

The power-discharge curves are obtained by plotting the discharge of the turbine in cubic feet per second against the output of the generator in kilowatts. For example, at 800 cu.ft.-sec. discharge, the generator output of unit No. 5 is 4,900 kw. At this discharge the kilowatts per cubic foot-second are 4,900 ÷ 800 = 6.125, and this value is found on the curve of kilowatts per cubic foot-second by taking the 800-cu.ft.-sec. point and projecting to the right. The kilowatts-per-cubic-foot-per-second curves, it will be noted, were obtained by dividing the total kilowatt output by the total cubic-foot-seconds input.

The curves $\frac{\Delta Kw.}{\Delta Cu.ft.\text{-}sec.}$ were obtained by taking increments of power and dividing them by increments of discharge at intervals along the power-discharge curves. For example, on the power-discharge curve of unit No. 5, Fig. 4, at a load of 4,000 kw., the discharge of the turbine is 690 cu.ft.-sec. To develop a load of 5,000 kw. required 814 cu.ft.-sec. This increase of 1,000 kw. in load increment B requires an additional discharge through the turbine of 814 — 690 = 124 cu.ft.-sec. as represented by the increment A. The $\frac{\Delta Kw.}{\Delta Cu.ft.\text{-}sec.}$ at this point on the curve is equal to $\frac{B}{A} = \frac{1{,}000\ Kw.}{124\ Cu.ft.\text{-}sec.}$ = 8.07 kw. per cu.ft.-sec. As will be noted, the power-discharge curves in this case are straight lines nearly to the points of maximum efficiency, and therefore the value of the $\frac{\Delta Kw.}{\Delta Cu.ft.\text{-}sec.}$ for this portion of the curves is constant, as represented by the horizontal portion of these curves.

Where the power-discharge curve starts to bend away from a straight line can be determined by laying a straight-edge along the curve. For example, the power-discharge curve for unit No. 5 is a straight line up to point C. Beyond this point the curve begins to droop and the curve $\frac{\Delta Kw.}{\Delta Cu.ft.\text{-}sec.}$ falls off rapidly. The reason for the latter will be seen by considering the kilowatt increment E, which equals 340, and discharge increment D, which equals 47.5. Dividing the former by the latter gives 340 ÷ 47.5 = 7.16 kw. per cu.ft.-sec., instead of 8.07, as obtained at A and B. The value of the ratio of increment E to D is indicated at F on the $\frac{\Delta Kw.}{\Delta Cu.ft.\text{-}sec.}$ curve.

If this incremental curve serves no other purpose, it should at least serve as a warning to the operator that in loading the units beyond the point of maximum efficiency, the incremental use of water becomes inefficient at a rapidly increasing rate. The incremental efficiency at the end of the power-discharge curve reaches a value as low as about 25 per cent. Where the curve $\frac{\Delta Kw.}{\Delta Cu.ft.\text{-}sec.}$ crosses the kw.-per-cu.ft.-sec. curve it indicates the point of maximum efficiency on the turbine and it is as near as possible to this point that the turbine should be operated.

Fig. 3 shows the various plans of operating unit No. 5 in combination with units Nos. 1 to 4, based on the power of each under a gross head of 94 ft. These curves were constructed by combining the power-discharge curves of Fig. 4. For example, plan A uses unit No. 5 to carry load up to its point of best efficiency, then unit No. 1 is added and loaded up to its point of best efficiency, followed by units Nos. 2, 3 and 4. The load curve is indicated by the full line a, b, c, d, e, f, g, h, i and j. This plan is premised upon the assumption that until all units are in service and water is plentiful no unit will be operated beyond the load at its best efficiency. If the load is extended beyond the points of best efficiency after all units are on the system, it will follow up on the full line j to z'.

Plan B starts with unit No. 1, which is loaded up to its point of best efficiency, after which is added units Nos. 2, 3, 4 and 5 consecutively as the load increases to the point of best efficiency, as indicated by the dot-and-dash line, k', k, l, m, n, o, p, q, r, j and z'. In plan C, each unit is loaded up to its maximum capacity, beginning with unit No. 5, before adding another unit, and is indicated by the line a, s, t, u, v, w, x, y, z and z'. This plan is included in order to show the effect of the inefficient use of water when the units are operated above their points of best efficiency.

From the full range of station load, from near full load on unit No. 5 to full station load, the discharge

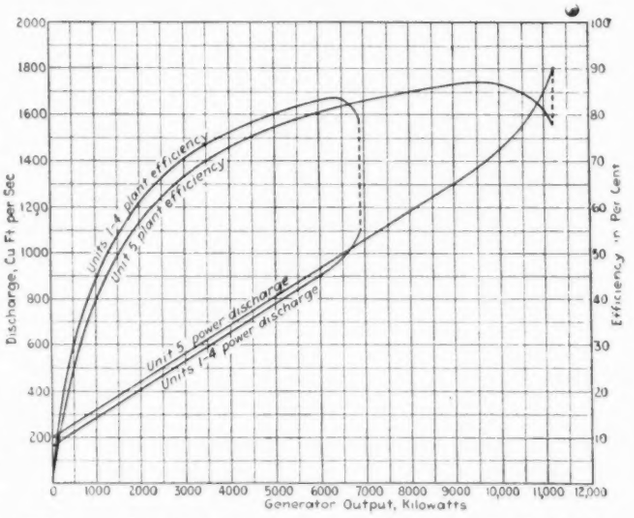


Fig. 2—Comparison of power-discharge and plant-efficiency curves for unit No. 5 and units Nos. 1 to 4

required to produce a given kilowatt output by plan C is greater than for plans A or B. At a station load of 34,800 kw., which is the load that can be carried with all units operating at their best efficiency, using plan A or B requires 5,160 cu.ft.-sec. discharge. If plan C were adopted to carry the load, 5,630 cu.ft.-sec. would be required, a difference of 470 sec.-ft., which at the average plant efficiency for plan A or B will produce more than 3,000 kw. This value decreases as the load on the plant decreases, but it indicates clearly the advantage of operating the units in accordance with a proper plan of operation.

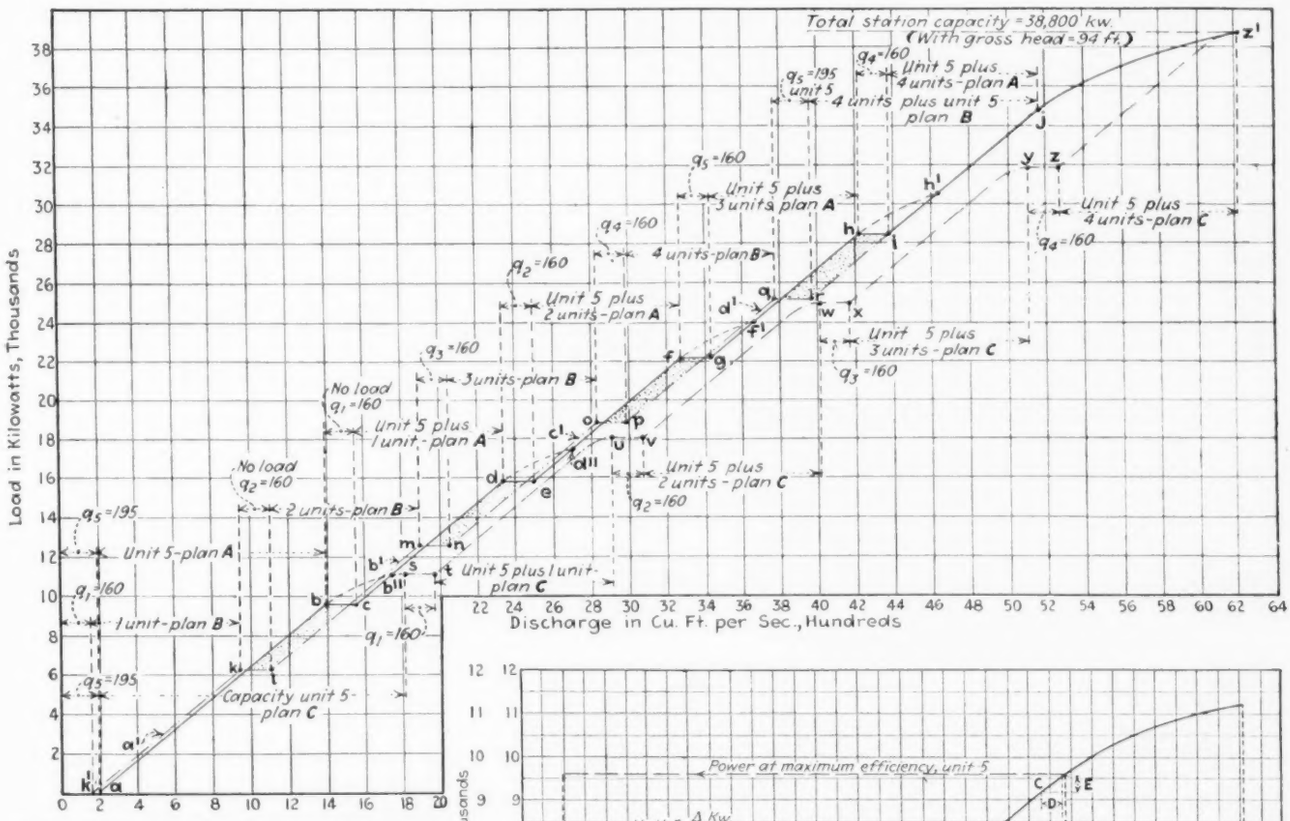
Fig. 5 shows a schedule of operation for the station as represented by plan A in Fig. 3 and gives the relation between station load in kilowatts and station discharge in cubic-feet-seconds under gross heads of 92

ft., 94 ft. and 96 ft. for one to five units in operation. A comparison of the power-discharge and plant-efficiency curves for unit No. 5 and units Nos. 1 to 4, Fig. 2, shows that from zero load to 6,650 kw., units Nos. 1 to 4 have higher efficiencies than unit No. 5. This is due to the fact that any load below 6,650 kw. represents a smaller percentage of full gate opening on unit No. 5 and therefore is at a relatively lower load point on the efficiency curve than would be the same load on units Nos. 1 to 4. This advantage of the smaller units can be utilized at certain conditions of load as shown in Fig. 3 by the areas *a'*, *b'*, *c'* and *d'*. A comparison of efficiencies for the same percentage of full load of the units shows No. 5 to have higher efficiencies throughout the entire range than Nos. 1 to 4, with approximately 3½ per cent higher maximum efficiency, and therefore with a higher average efficiency over the operating range.

Plan *A* is premised upon using unit No. 5 to carry the base load, thereby obtaining the advantages of its higher average efficiency over the operating range, whereas plan *B* is premised upon the efficiency advantages of the smaller units at loads below 6,650 kw. A comparison of areas *a'*, *b'*, *c'* and *d'* with the shaded areas on Fig. 3 shows that the average plant efficiency is higher with plan *A* than with plan *B*, and the former was therefore adopted for the schedule of operation under various heads.

The curves in Fig. 5 are similar to the curve *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *j* and *z'*, Fig. 3, except that they are shown for three different heads, and the curves, in Fig. 5, have been extended beyond the point of maximum efficiency to show the maximum load that can be carried on the different groups of units.

For greatest economy in the use of water, the units should not be operated beyond the loads at maximum efficiency, except when by so doing the use of an additional unit to carry the load is unnecessary, or in case of an emergency. Operation beyond the point of maximum efficiency should be directed by the dotted lines *b-b''*, *d-d''*, *f-f'* and *h-h'* on the curves, Fig. 3, and corresponding lines on Fig. 5. These curves for the


Total station capacity = 38,800 kw.
(With gross head = 94 ft.)
Load in Kilowatts, Thousands
Discharge in Cu. Ft. per Sec., Hundreds
Unit 5-plan A
1 unit-plan B
Capacity unit 5-plan C
No load
2 units-plan B
Unit 5 plus 1 unit-plan A
3 units-plan B
Unit 5 plus 2 units-plan A
4 units-plan B
Unit 5 plus 1 unit-plan C
Unit 5 plus 2 units-plan C
Unit 5 plus 3 units-plan A
Unit 5 plus 3 units-plan C
Unit 5 plus 4 units-plan A
4 units plus unit 5 plan B
Unit 5 plus 4 units-plan C

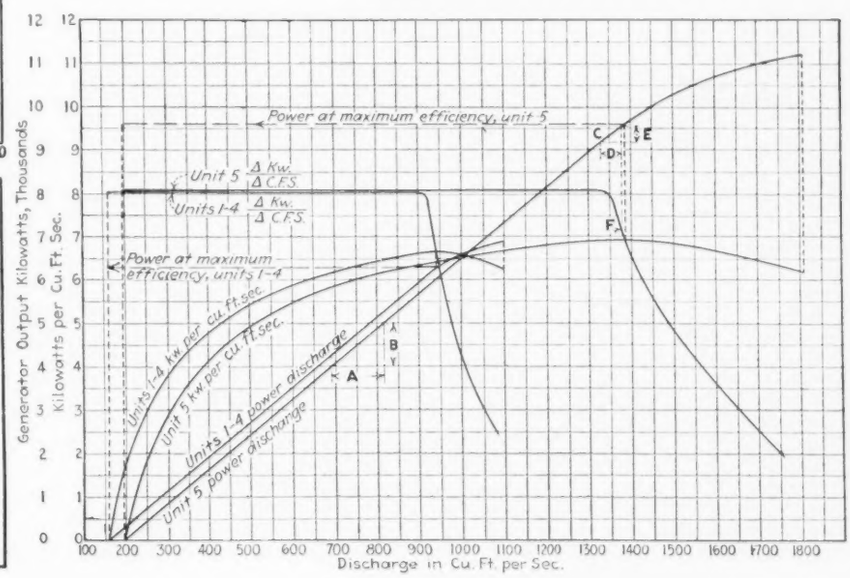

Power at maximum efficiency, unit 5
Unit 5 Δ Kw. / Δ C.F.S.
Units 1-4 Δ Kw. / Δ C.F.S.
Power at maximum efficiency, units 1-4
Units 1-4 kw. per cu. ft. sec.
Unit 5 kw. per cu. ft. sec.
Units 1-4 power discharge
Unit 5 power discharge
Generator Output Kilowatts, Thousands
Kilowatts per Cu. Ft. Sec.
Discharge in Cu. Ft. per Sec.

Fig. 3—(Above) Various plans for operating unit No. 5 in combination with units Nos. 1 to 4

Fig. 4—(Right) Power-discharge and kilowatts per cubic-foot-second curves

operation of unit No. 5, in conjunction with one or more of the smaller units beyond their loads at maximum efficiency, were developed with the relation shown by curves *A* and *B*, Fig. 5. These show that for any given increase of load beyond that corresponding to the sum of the loads at the points of maximum efficiency of the units in operation the division of such increase in load between unit No. 5 and one of the smaller units for the same efficiency in the incremental use of water should be in the ratio of 3 to 1. For example, let it be assumed that No. 5 unit and two of the other units are operating at or near their points required per 100-kw. load is about the same as when 300 kw. has been added to one of the smaller units. This relation of 9 to 3, or 3 to 1, it will be noted, holds fairly constant throughout the range of loads above maximum efficiency. Therefore, as previously pointed out, for every 100-kw. load placed on one of the smaller units above its maximum efficiency, 300 kw. should be put on unit No. 5 to obtain the most efficient use of the water.

It is to be expected that certain conditions of load may warrant a departure from plan *A*. For any given load and conditions the operator can readily determine

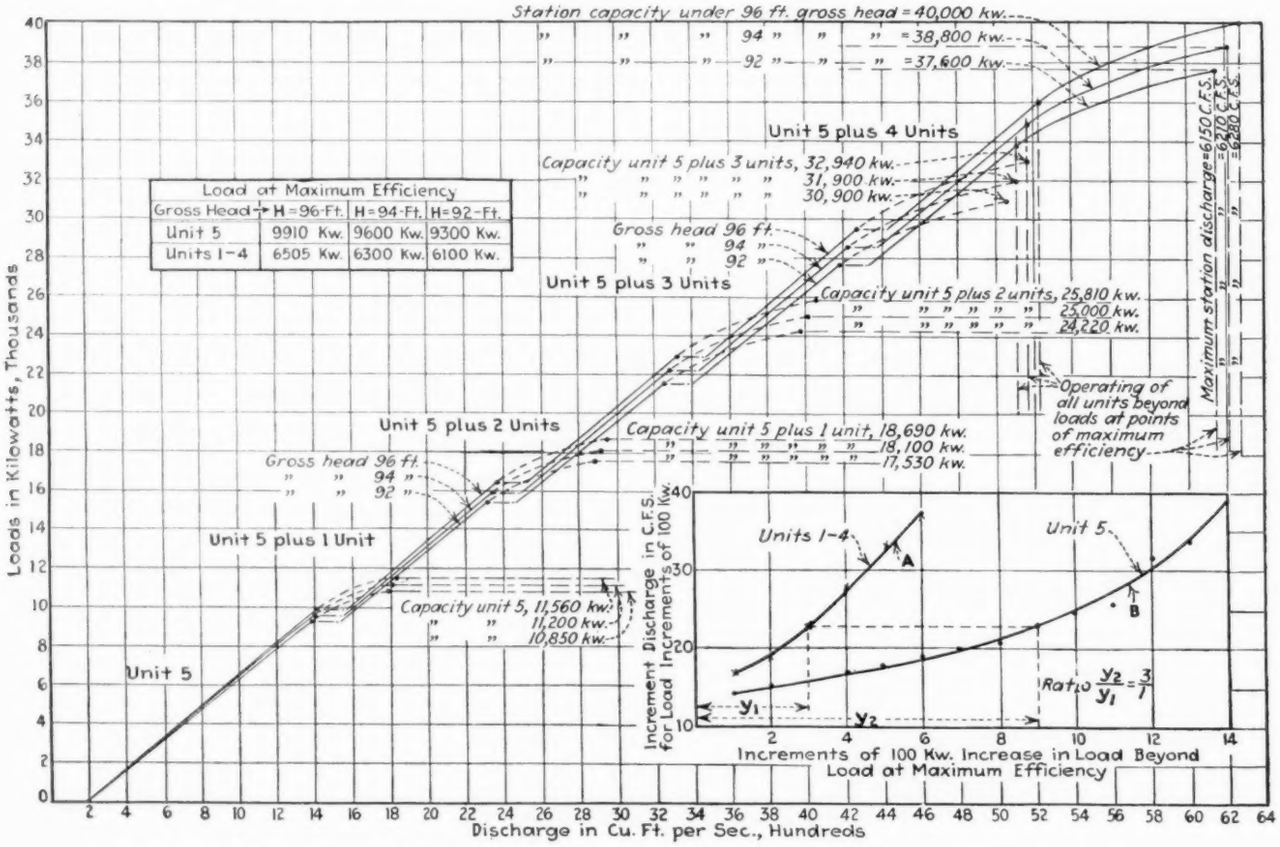

Station capacity under 96 ft. gross head = 40,000 kw.
" " " 94 " " " = 38,800 kw.
" " " 92 " " " = 37,600 kw.
Unit 5 plus 4 Units
Capacity unit 5 plus 3 units, 32,940 kw.
31,900 kw.
30,900 kw.
Load at Maximum Efficiency
Gross Head → H=96-Ft. H=94-Ft. H=92-Ft.
Unit 5 9910 Kw. 9600 Kw. 9300 Kw.
Units 1-4 6505 Kw. 6300 Kw. 6100 Kw.
Gross head 96 ft.
" " 94 "
" " 92 "
Unit 5 plus 3 Units
Capacity unit 5 plus 2 units, 25,810 kw.
25,000 kw.
24,220 kw.
Maximum station discharge = 6150 C.F.S.
= 6270 C.F.S.
= 6380 C.F.S.
Operating of all units beyond loads at points of maximum efficiency
Unit 5 plus 2 Units
Capacity unit 5 plus 1 unit, 18,690 kw.
18,100 kw.
17,530 kw.
Gross head 96 ft.
" " 94 "
" " 92 "
Unit 5 plus 1 Unit
Capacity unit 5, 11,560 kw.
11,200 kw.
10,850 kw.
Unit 5
Loads in Kilowatts, Thousands
Discharge in Cu. Ft. per Sec., Hundreds
Increment Discharge in C.F.S. for Load Increments of 100 Kw.
Units 1-4
Unit 5
A
B
Ratio $\frac{y_2}{y_1} = \frac{3}{1}$
y_1
y_2
Increments of 100 Kw. Increase in Load Beyond Load at Maximum Efficiency

Fig. 5—Plan for loading the units in accordance with plan A, Fig. 3

of maximum efficiency, and it is desired to develop 500 kw. more without the addition of another unit. The best use of additional water would dictate that 300 kw. of the required increase be carried by unit No. 5 and 100 kw. by each of the two smaller units.

Curves *A* and *B*, Fig. 5, have been obtained by starting at the point of maximum efficiency of the power-discharge curves, Fig. 4, and obtaining the discharge for each 100-kw. increase in load and plotting the latter as abscissas against the former as ordinates. For example, for the first 100-kw. load above the point of maximum efficiency on unit No. 5 an increase in turbine discharge of 14 cu.ft.-sec. is required, and for one of the smaller units 17 cu.ft.-sec. At 600-kw. increase in load above maximum efficiency on No. 5 unit, 19 cu.ft.-sec. is required to develop 100-kw. increase in load, and on one of the smaller units the discharge for a similar increment of power is 37 cu.ft.-sec.

From curves *A* and *B* Fig. 5, it will be seen that in adding a load of, say, 900 kw. on unit No. 5, above its point of maximum efficiency, the cubic feet of water by inspection of Fig. 3, in conjunction with Fig. 5, what if any, departure is warranted.

It is also to be expected that due to the necessity of a certain amount of reserve capacity and on account of fluctuating load conditions and other variable factors entering into the operation of the station, it may not be possible to adhere strictly to any predetermined plan of operation, or to obtain 100 per cent adjustment of load in accordance with such plan. It is thought, however, and may reasonably be expected, that to make use of the performance data established by test in accordance with such a plan as a guide in the operation of the station will give a more efficient use of the source of energy and produce greater annual output of kilowatt-hours.

Where power-discharge and efficiency curves, obtained by field tests are not available, then the manufacturer's curves, stepped up from tests on models, may be employed for working up a plan of operation. However, where possible, field tests should be made and this information used in the operating schedule.

Power-Plant Opportunities

An Answer to Power-Plant Engineers Who Are Losing Faith in Their Future, by One Whose Occupation Daily Brings Him in Contact with Many Operating Men in the Middle West

By LYNN L. ARMANTROUT

AS IN EVERY other line of work, there are many skeptics who doubt that their profession offers anything to any man except a job and steady work. For such men and to young engineers who are naturally anxious to know what chances there are for those who must spend years working to gain the knowledge and experience necessary to master the profession, the writer is presenting his opinion of the situation, as viewed from the standpoint of one who has been a power-plant engineer for several years and is now associated with that line.

Most rules handed out to us give hard work as the chief, if not the entire, requisite for success; but thinking power-plant men know that hard work is merely one of the many things the engineer must be master of, if he is to attain the highest goal in this profession. Hard work, ready acceptance of responsibility, sincerity and many other such qualities are items of every-day practice for the engineer.

OPPORTUNITIES in the engineering profession, and especially in power-plant engineering in branches pertaining to economical steam or electrical power generation, distribution and utilization, were never so great as now. Incentives for engineers to attain knowledge and skill in their profession are greater than ever before and are sure to grow for many years. Power is needed and wanted, and success is assured those engineers who can efficiently deliver it, who can locate the demand for their abilities and convince those interested of their worth. Such a program will require hard work, but when followed with an accurate judgment of values, will result in engineering success.

To consider properly the possibilities of power-plant engineering, it must be recognized that there is only one way for anyone in any line to be successful; that is, to have something someone else wants. This can be accomplished in one of three principal ways: Own or control something of material worth such as land, money or privilege; know something someone else wants to know; or be able to do something someone else wants done.

It is, therefore, important to judge values, to recognize valuable knowledge and to foresee the things necessary to be done. Success will come sooner because of the saving in time ordinarily spent in getting useless knowledge, and by preventing the waste of labor in acquiring skill at a useless task.

Demand for Power

There is a big movement now under way to abandon small, inefficient, isolated plants serving mills and factories, and to have them buy power from central stations. Many engineers look upon this tendency with growing apprehension and give it as the reason for their doubts regarding the engineer's future. This will not damage the capable engineer, although it may force him to make a change of plants. Engineers who have kept well informed and alert to changes in power-plant practice will find there are many more good jobs open than formerly, and although it may be hard to make a change at the time, they often find that they have bettered themselves. For every plant of considerable size, where the engineer's job was really worth while, that abandons its own equipment to purchase power, there are two or more permanent plants needing capable engineers. Fifty and even twenty-five years ago, particularly in power plants serving the industries, engines, boilers and their auxiliaries were simple. In many of them a clerk could be taught to run the plant in a few days, and numerous factories relied on casual laborers to man their power houses. The number of plants requiring experienced operators were fewer than now and employment was more uncertain. The boiler and engine rooms were dirty and unsightly, and no consideration was given to ventilation. Long hours under such conditions made an engineer's life in the "good old days" anything but inspiring. This is not true today. The engineer's health and well being are considered in practically all of the larger plants, and hours and pay are arranged to allow him a chance to enjoy a fair amount of the better things in life. The real capable engineers are fewer than ever before in proportion to the plants in operation. Even remote small power plants now have boilers mechanically operated and controlled. Most of them are generating electricity and demand that only an experienced engineer be put in charge. No longer can a non-mechanical man be pressed into service for a few days to operate the power plant.

Why, then, all this talk of the growing scarcity of opportunities in the steam-engineering field? It would seem that there must be something seriously lacking in the engineering viewpoint of the doubters. People want power more than ever before. Industries depend on power more than formerly, and even the homes and farms demand power derived from steam. No person living in a settled community in America goes a day or even a minute of his conscious life without seeing and relying on products of the steam power plant. And the demand is increasing, not lessening.

A man considering power-plant engineering as his

life's work can be assured that if he can qualify, he will have something of material value that other people want and will continue to demand in ever-increasing measure as time goes on. This should satisfy him on the first point in the question of choosing a class of work containing elements that offer opportunities for a successful career.

Engineering Knowledge

No engineer gets very far and it is safe to say that never will he control a large power plant until he has acquired much knowledge and has had years of experience. Practical, technical, theoretical and experimental knowledge enter into the training until he is well equipped mentally. To be a successful chief engineer, the technical knowledge necessary is great enough to comprise the life's work of an average man. The law, medical or commercial professions demand no more specialized knowledge than does the profession of engineering. Engineers surely can be said to possess knowledge that is wanted and that all of us pay for in some measure.

Steam-engineering knowledge is in demand everywhere, affording opportunities not open to the old-time men. Meters, gages, regulators, recording thermometers, etc., are now available, so men who care to study steam, its basic elements and relative values under various conditions can do so.

With engineering knowledge and with the aid of meters one can now detect faults and correct them and so make for himself a record that was formerly impossible. For instance, the writer was in a large factory a few months ago where six out of every seven cars of coal went to furnish steam and hot water for factory process work and where all returns from factory units drained into the sewer, whereas raw water was fed to the boilers at 180 deg. F. That was a large plant in a city, equipped with stokers, uniflow engines and other up-to-date apparatus. A new management with a knowledge of steam properties is now saving weekly large sums of money in that plant. This is only one example from hundreds of plants where the operating conditions are apparently ideal but where a better knowledge of steam would result in large reductions in power costs.

In new plants where high pressures and superheat are used, boilers and auxiliary equipment are showing signs of things having occurred within them, and to them, that are so new in practice and offer such big unsolved problems regarding the reasons for them and the means of preventing or overcoming the faults that it is realized steam knowledge is only partly complete. It can be concluded confidently, therefore, that the power-plant man who really knows is in demand.

Manual Skill

Probably the condition that most nearly justifies the statement that the power-plant engineer's opportunities are not what they formerly were is the matter of skill at manual tasks required of present-day power-plant men as compared with that required of the old plant operators. It is surely true that today the man who works his way up through the plant by sheer physical effort and who has not given time and study to the theoretical principles of steam generation and some study to executive problems stands a much poorer chance for advancement to a responsible position.

Skill in operating is required in vastly increasing measure. Boiler-room operators are not the manual laborers they were at one time. Stokers, fans, gages, meters and other equipment require experienced operators who must combine this skill with a knowledge of combustion principles. The same is true with the engine operators. High-speed turbines, with their oiling systems and auxiliary units, require skill and experienced observation.

In the foregoing paragraphs the writer has endeavored to show that the power-plant field contains all the incentives for individual progress to be found in any line of work. The demand for power privileges, power knowledge and power-plant skill has never been so great as now and plans are already under way in most localities that will increase the demand for men who are masters of any phase of the profession.

The power plant calls for men versed in power-plant construction, power generation, distribution and utilization. Branches of these divisions call for mathematicians, lawyers, accountants, chemists, metallurgists, designers and specialists of all descriptions. Most of these positions are open to the man of training, and the man who specializes in any branch after having received practical training in power-plant operation is much better equipped for future responsibilities by having had such experience.

Realizing on Ability

As there are three main requisites comprising the necessary elements for success, so there are conditions that must be met in order that the possessor may realize his desire to the fullest extent. Where the desire and demand for one's possession is actually existing, engineers who can supply this demand must demonstrate their possession or ability and convince their principals that they have the desired knowledge or skill that is wanted. When the engineer has such merits and can fulfill the requirements, he will receive fair consideration from practically all engineers. No profession offers as much encouragement and willingness to accept new knowledge in its line as does engineering. That is undoubtedly the reason for the great advancement of this profession and its improved ethical standing during the last few years.

Specific Gravity of Oil, usually measured in degrees Baumé at 60 deg. F., is little more than a general indication of the properties that may be expected. As it has become the set commercial practice to grade fuel oils according to specific gravity, they usually must be purchased on this basis, and it will be found that fuel oils ranging between 24 and 34 deg. Baumé at 60 deg. F. are usually to be preferred. Some oils heavier than 24 deg. might be used, but fuels lighter than 34 deg. should be avoided, as they generally are more expensive and have a tendency to wash off lubricants. The flash point is of importance only as it affects safety and storage and usually would be objectionable only if under 125 deg. F.

The Drainage of a Steam Header is most important. All connections to and from the boilers and engines should enter the header at the top to insure that any water that may collect in the header will not be picked up and carried to the engine. To carry away this water the header should be fitted with one or more drains of ample size, connected to good high-pressure traps to avoid loss of steam.

Welding the Cylinder of a Corliss Engine

By W. J. Allison

THE EXTENT to which broken machinery and damaged power-plant equipment may be reclaimed by the process of oxyacetylene torch welding is illustrated by the repair recently made on a Corliss engine.

The follower plate of a built-up type of piston in the high-pressure cylinder of a tandem-compound Corliss engine broke. A V-shaped segment dropped out of place and caught between the piston and cylinder head, resulting in a broken high-pressure cylinder.

This engine is 24x46x36-in., direct connected to a 24x40-in. ammonia compressor. At the time of accident

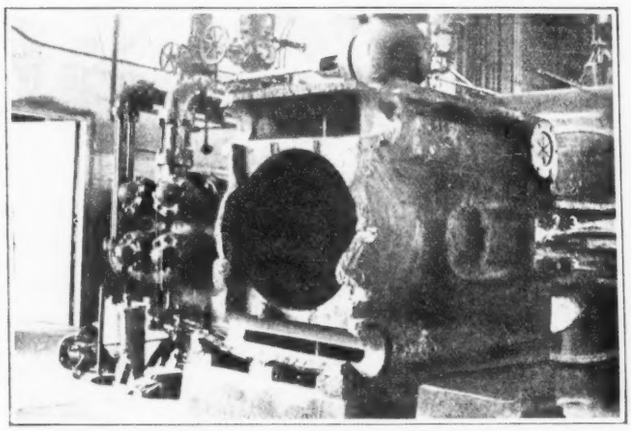


Fig. 1—The end of the cylinder broke off

it was running 67 r.p.m. Fortunately, no one was injured as a result of the blowout.

As will be seen from Fig. 1, the entire head end of the high-pressure cylinder was broken off, fracturing into three pieces, on almost a straight line down through the center of the steam-valve chamber and through the cylinder proper and exhaust-valve chamber, taking off approximately 6 in. of the end of the cylinder. The cylinder head and piston were broken into fragments, while the 4⅛-in. piston rod was badly bent and had to be cut with a torch before it could be removed through the crank end of the low-pressure cylinder.

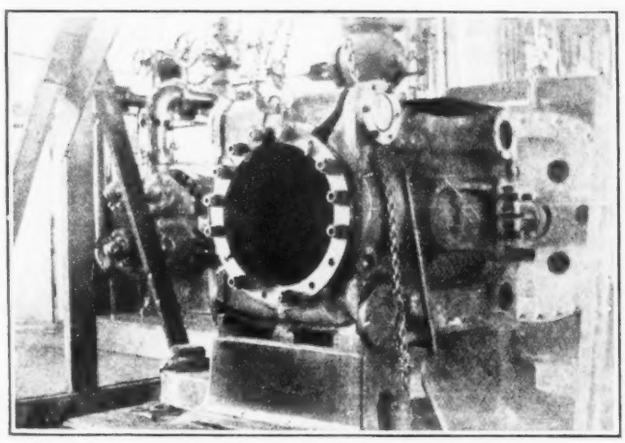


Fig. 2—Broken parts in place ready for welding

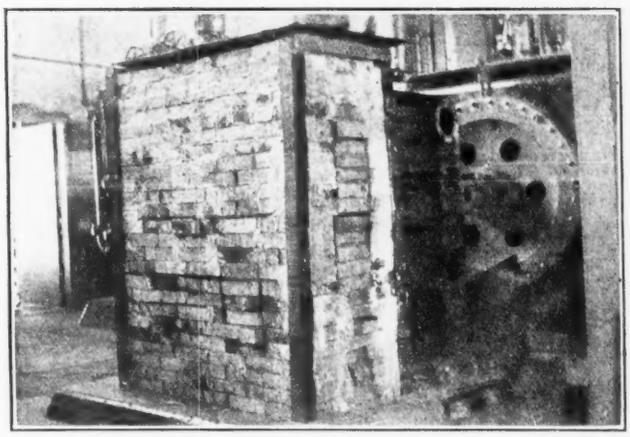


Fig. 3—The welding torch was introduced through the furnace side

Naturally the first thought was to get a new cylinder, which, inquiry revealed, would cost about $1,200. This brought up the subject of welding the broken cylinder, and the representative of a well-known firm the business of which is oxyacetylene welding was called in. Upon his decision that a first-class job could be done, materials were ordered and the broken edges of all parts were scarfed at an angle of 45 deg., then assembled and held in place with tie rods and a 1x3-in. ring was drilled to fit the stud circle of the cylinder, as shown in Fig. 2.

A preheating furnace, Fig. 3, was built around the head end of the cylinder. An opening in the side was

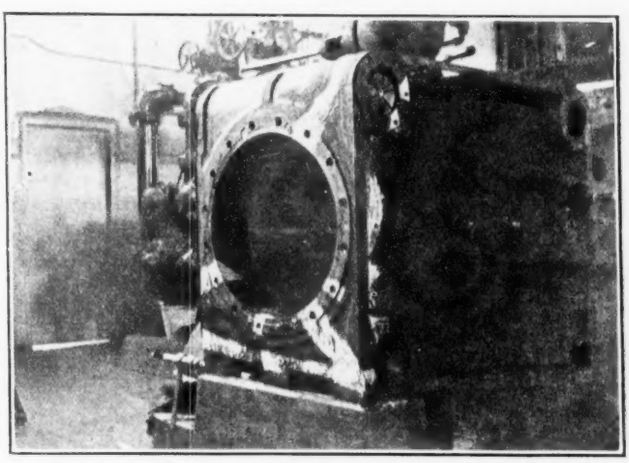


Fig. 4—The cylinder after welding and reboring

closed with a tier of brick, which was removed, one brick at a time, to permit the welding to proceed.

The furnace was filled with charcoal, and after being lighted, was given five hours to preheat, after which the crew of five welders started to work, working in relays of two men per shift until the job was finished. The total interval from the time the fire was lighted to the completion of the welding was 21 hours, giving a total of 63 man-hours for welding.

This job was welded with tobin bronze, using 216 lb. of ¼-in. rods. Other materials used were 1,270 cu.ft. of acetylene, 1,339 cu.ft. of oxygen and 5½ lb. of bronzing flux.

The fire was allowed to die out and the cylinder to

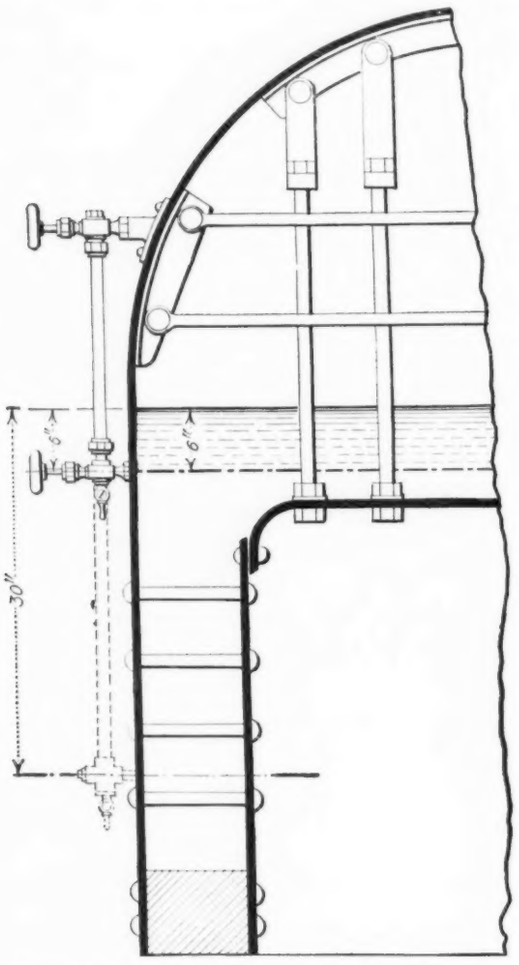
cool off, which took two days. The furnace was then removed and an examination made of the welding. It was found to be first class, with the exception of a blowhole under the neck of the steam-valve chamber, which was filled by inserting a threaded 1-in. tobin bronze plug.

The cylinder had warped only very slightly, but it was necessary to rebore it, as well as the two valve chambers. The completed cylinder after the reboring was done is shown in Fig. 4. The light streaks are the welded joints.

After all work was done, a cold water test of 170 lb. per square inch gave no sign of a leak, which convinced us that the machine was as good as new and ready to go back in service. The total cost of the job was approximately one-half the cost of a new cylinder.

Effect of Gage-Glass Connection on Indicated Water-Level

THE density of water at 70 deg. F. is given in the Marks & Davis Steam Tables as 62.3 lb. per cubic foot. Its density at 400 deg. F. is given as 53.5. It would therefore take a column of the cooler water only 53.5 ÷ 62.3 as high to balance a column of water at 400 deg.



Carrying the water connection too low would increase the error

If, in the sketch, the water in the boiler were at 400 deg. and the water in the glass 70 deg., it would require a column only (53.6 × 6) ÷ 62.3 = 5.15 in. high to balance the 6-in. column inside, and the reading would be 6 — 5.15 = 0.85 in. too low.

If instead of being connected directly into the boiler the water connection dropped to 30 in. below the water line, as shown dotted, the column of 70-deg. water in the pipe would need to be only (53.5 × 30) ÷ 62.3 = 25.8 in. and the reading would be too low by 30 — 25.8 = 4.2 in., which is more than two-thirds of the height of the column of water that ought to be indicated by the level in the glass.

This assumes that the temperature of the water in the glass and the pipe leading to it is 70 deg. and that of the water in the boiler 400 deg. and that they are both solid water (that is, without bubbles) and not in motion. The water in the glass and pipe may be a little warmer than this, but it is solid and at rest. The water inside the boiler is full of bubbles of steam and in active circulation when the boiler is in operation. This tends to make the pressure at a given depth in the boiler still less and to diminish further the height of the coolor water, in the pipe and glass, necessary to balance it.

Considerable difference between the water level and the level at which the water connection of the gage or column enters the boiler is likely to be the cause of grossly false indications as to the amount of water there is in the boiler. The error is in the direction of safety so far as the boiler is concerned, in that the water level indicated is too low and would lead to too much rather than too little water being supplied. It might lead, however, to a wrecked engine or mutilated turbine through water being carried over.

Another reason for not carrying the water connection too low is the danger of sediment being drawn into it, especially if it is attached slightly above the mud ring of a firebox boiler.

A MAGNETIC AMMONIA-COMPRESSOR VALVE—In a paper presented to the Victorian Institute of Refrigeration at Melbourne, Australia, H. J. Hilton pointed out that at no time during the suction stroke does the charge of gas in the cylinder equal in density that of the source from which it is drawn, the spring-weighted suction valve of the compressor acting as a reducing valve. The spring force on the valve being constant, the efficiency of the machine is adversely affected as the back pressure becomes less. To overcome this condition he has devised a valve that opens to its fullest extent at the beginning of the suction stroke and remains so throughout the entire stroke. Inside the cap of the valve is a solenoid with a soft-iron core. Electric connections are made to a commutator on the crankshaft, the contact being made and broken at the proper centers. Application of current opens the valve instantly, and at the break of the circuit the spring immediately closes the port.

DISCUSSING THE USE OF FORGED STEEL DRUMS for high-pressure boilers, *Engineering* (London) recently mentioned a steel container produced by a Sheffield manufacturer for oil cracking. This was forged from the solid. The length was 41 ft., the diameter 4 ft. and the wall thickness 4 in. It was tested with a hydrostatic pressure of 10,000 lb. per square inch.

How Stringent Should a Test Be?

FROM TIME TO TIME engineers have questioned the advisability of running machinery acceptance tests under conditions far more severe than are to be met by the equipment in service.

It is difficult to convince the skeptical that a boiler placed under a 50 per cent over-pressure by a hydrostatic test at the factory may be assumed to be safe after erection a thousand miles away. No matter how tight rivets and tubes may test, the rough treatment received in unloading and moving may start a dozen leaks. No one argues that a hydrostatic test proves that the boiler will be safe a year hence, and its only excuse is that of permitting inspection for leaks. But is it worth while to put a stress on the boiler that it will never experience in service?

The same objection has been raised to the testing of steam engines and turbines. If an engine is to be operated on saturated steam, why test with superheated steam?

Recently unusually severe tests were undergone by Diesel engines contracted for by the Shipping Board. These engines in service will use a filtered refined oil usually sold as Diesel fuel oil, and if a dirty undesirable oil is ever used, it will be only because of an emergency. In the acceptance tests these engines have been operated on a fuel of unusually unfavorable characteristics. In one instance the percentage of sulphur was almost five. Now, it is self-evident that dirty, sulphurous oil is likely to cause cylinder wear, and doubt has been raised as to the usefulness of such tests.

Those familiar with Diesel engines know that such units, regardless of make or type, can be operated on oil heavy with sulphur and grit. If this be true, what advantage will be gained by subjecting engines to such rigorous tests when the natural result will be wear of the running parts?

Higher Steam Temperatures

INTEREST in the economic possibilities of higher steam pressures is steadily increasing. Last year's report of the Prime Movers Committee of the National Electric Light Association showed that large savings were possible by the use of higher steam temperatures. A prominent valve manufacturer has announced a new line of chrome-steel valves for six hundred pounds steam pressure and for temperatures as high as one thousand degrees Fahrenheit.

Up to the present time engineers have not considered it advisable to employ steam temperatures in excess of seven hundred and fifty degrees. They have generally based this decision on the fact that the ultimate strength of steel as shown by short-time tensile tests falls off rapidly beyond this temperature. There are other factors besides this strength to be considered.

First there is the so-called flow at high temperatures. It has been shown by Dickinson in England that steel at high temperatures and under high stress elongates steadily until rupture occurs. This characteristic of steel has recently been investigated by the Bureau of Standards and is discussed in one of the bureau's recent papers on "Flow in Low-Carbon Steels," by H. J. French and W. A. Tucker. The tests made in Washington indicate that at high stresses this steel may have a short life, but at low unit stresses the steels appear to be able to stand the high temperature indefinitely with only a small initial elongation, which soon ceases. These tests indicate that it is possible to design parts of low-carbon steel that will be satisfactory under high temperature provided low unit stresses are used. Such parts must be quite heavy.

The second factor is the performance of steels at high temperatures under repeated stresses. Little data are available on this subject. Fatigue tests made in England at various temperatures indicate that the fatigue limit does not decrease appreciably at high temperatures below that at normal temperature. This would seem to indicate that a part designed within the safe flow limits at high temperatures would be within the fatigue limit as well. If further experiment verifies this fact, then our engineers can intelligently design steam machinery for higher steam temperatures. There are many indications that this step to higher temperatures will be made in the near future and the economy of our steam stations will be materially improved by the use of such higher temperatures.

Exhaust Versus Live Steam for Heating

IT IS universally admitted that the use of a steam engine in place of a reducing valve in lines supplying steam for heating buildings cannot increase the fuel consumption by any large amount. Many engineers, particularly some in charge of heating plants, go further than this in claiming that the engine actually reduces the total fuel consumption. When the technically trained engineer argues that this is impossible and contrary to the established laws of thermodynamics, he is confronted with "facts" to confound his theories.

In view of the well-established scientific law that energy cannot be destroyed or manufactured, it is hard to understand how the energy exhausted by an engine could exceed that supplied at the throttle. In fact, repeated tests have shown that the exhaust energy is less than that at the throttle by the equivalent of the power generated and the external heat losses of the generating unit.

There remain two possible explanations of the reported fuel savings. One is that they are not due directly or indirectly to the use of an engine, but rather to variations in such external conditions as outside tem-

perature and wind velocity. It is a serious error to compare heating conditions for two periods on the basis of outside temperatures alone, without giving due consideration to the velocity and direction of the wind.

The other possible explanation of data showing reduced coal consumption where power is generated would be that the periods of power generation coincided more or less exactly with certain changes in internal conditions. With external conditions constant, the amount of steam heat required to warm buildings may be affected by many factors. Among these may be mentioned the heat given off by occupants and by fuel consumed in the building for manufacturing purposes, the opening and shutting of windows, variations in the temperature maintained and the waste of heat through steam discharged to the atmosphere or hot water lost to the sewer. Finally, changes in shifts or operating personnel may easily affect boiler efficiency.

Some of the theories so far proposed in explanation of the alleged fuel saving when an engine is used seem rather wide of the mark. Attention is sometimes called to the fact that an engine generally delivers wet steam, whereas the steam furnished by a reducing valve is slightly superheated. The wet steam, it is claimed, gives better heat transfer in the radiators. Others claim that the pulsations of the engine exhaust drive out air pockets and otherwise increase heat transmission. These arguments, if admitted, work in the opposite direction from that intended. Increased heat transfer means more coal rather than less. If one closes the radiator valve, throws a blanket over the radiator, leaves air pockets undisturbed, or does anything else to retard the radiation of heat, fuel is thereby saved—at the expense of comfort, of course.

A really scientific analysis of this question is badly needed and it is to be hoped that someone will supply the kind of data upon which an intelligent study may be based—data covering every factor that might materially affect the fuel consumption.

Wind Effect on Chimneys

ACTUAL TESTS on chimneys are not frequently made and little data on performance are available. Among the factors that may influence chimney performance, probably least is known about the effect of wind. The turning moment due to wind pressure must be considered in the design of the chimney and its stability established under heavy wind conditions.

There are other wind effects that cannot be computed so easily. For instance, what is the leakage of air into the chimney due to wind pressure? Is it appreciable? Some have held that chimney gases are diluted by such leakage. Naturally the chimney construction affects such leakage. Steel chimneys, if properly riveted and well painted, should show little or no leakage, whereas some brick or tile chimneys may show greater leakage. Few if any observations have been taken to established this leakage definitely.

The wind has a certain cooling effect on the chimney. The draft of a small steel stack may be affected to some extent by such cooling. It seems doubtful whether the heat losses through a tile or brick stack, even with a high wind, could produce much cooling effect on the gases.

Then there is the effect of strong wind on the top of the chimney. This may have an aspirating effect, thereby increasing the draft, or if directed into the chimney may have a depressing effect, lowering the total draft. The latter effect has been noted on chimneys located in deep, narrow valleys in prairie country where the wind tends to follow the contour of the land.

Suppose one had available accurate data on the wind velocities and direction of wind; how would the aspirating effect from these data be calculated? It is doubtful whether theoretical calculations, if available, would be of much use unless correlated by tests with actual chimney performance. These considerations indicate the need of more definite and accurate test data on chimneys and of correct methods for interpreting observations when these are taken. All the above effects should be noted at the time of test.

Concrete for Power Plant Foundations

CIVIL ENGINEERS have been compelled to devote considerable thought to the action of alkali water on concrete when the structure in mind will be located in a section of the country where such waters are encountered. The alkali belt extends over a large portion of our Middle West and up into Canada. There is ample evidence of the disintegrating effect of alkali water due particularly to the action of the dissolved sodium and magnesium sulphates in these waters. Troubles have been experienced with concrete sewers, culverts, gutters, retaining walls, water supply conduits and in certain cases with foundations. The failure generally takes the form of a crumbling away of the concrete due to the action of the alkali water.

Disintegration usually occurs near or just above the water line. It is assumed that the soil moisture is continually evaporated at this line. This evaporation increases the sulphate concentration in the capillary passages of the concrete. High concentration leads to the rapid formation of alkali salt crystals in the capillary pores. The expansive forces resulting from the growth of such crystals are sufficient to break off portions of the concrete or to shatter its internal bond so that it crumbles readily. Such disintegrated concrete cannot be depended upon to carry loads.

As this action appears to be largely due to high concentration in the pores of the concrete due to evaporation, the remedy seems to consist in such waterproofing and other treatment of the concrete that will prevent the absorption of moisture and hence prevent concentration and crystallization by evaporation. Either an impermeable concrete or one with carefully waterproofed surfaces throughout should be required in alkali soils.

Mechanical engineers are constructing large power plants at various points in the Middle West where alkali waters are encountered. If the ultimate safety of these structures is to be insured, it will be well to give careful consideration to every means to prevent disintegration of the concrete in such structures through the agency of the so-called alkali water. Fear has been expressed that in some cases these factors have not been given the consideration that they deserve.

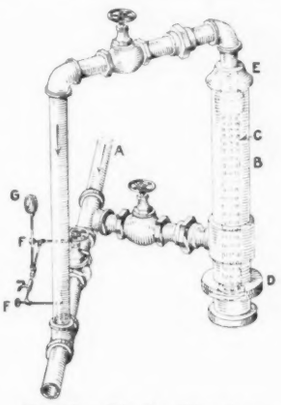
Garabed T. K. Giragossian, of perpetual motion fame, has again succeeded in interesting Congress as to the merits of his device, which is purported to be capable of producing energy continuously without the expenditure of fuel. Would that we had a few engineers among our national legislators.

Practical Ideas From Practical Men

A Home-Made Strainer

The accompanying drawing represents a strainer placed in a hot water main on the discharge side of the pumps for the purpose of removing particles of pump packing that may pass out with the waste. This wornout packing had made trouble by stopping up bibcocks and small pipes.

The strainer *B* stands vertically. It is made of pipe and fittings and is valved off from the hot water main *A* as shown. The pipe *C*, of which we have two for quick changing, is drilled full of ¼-in. holes. It has a coupling on one end and a cap on the other. The coupling joins the upper end of this pipe to a nipple which screws through the reducer *E* at the upper end of the strainer chamber. The perforated pipe *C* extends downward into the settling pocket *D*, and is accessible for changing after removing the pocket. A flange union here was preferred to obviate any difficulty in replacing the pocket from the dripping of hot water.



Easily Made Strainer

The gage *G* with valve *F* indicates when the strainer pipe *C* should be changed.

When the strainer is in use, it has been found that the pocket *D* collects considerable matter and that the holes in the strainer pipe *C* gradually close from the bottom upward. Since the installation of the strainer years ago, there has been no trouble from clogging.

Elgin, Ill. P. L. WATERS.

A Time-Saving Notebook

It sometimes happens that the man in charge of the mechanical equipment is wanted in opposite ends of the plant at the same time. Although both calls may be urgent, one of them may be only for information, which often can be given over the telephone, providing the data are at hand. In plants where machinery is constantly being removed and replaced, information concerning the speed and size of shafting in different parts of the plant is frequently called for by the agents for the machines. Since it is impossible to carry in your head these figures for a plant with several floors and a number of buildings, it is necessary to take the measurements each time, and such times seem to come when you are busy doing something else. In our plant we have a loose-leaf notebook that has solved this difficulty as well as acted as a check on other things. We had several 8x10-in. form sheets printed like the sample shown, using only one side of the paper. Enough sheets were put in the notebook so that there were several spare sheets after allowing one sheet for each line of shafting. All the needed information for each line of shafting and its motor was gathered and the forms were filled out with a pen.

Now, when a call comes to the engine room concerning the speed of a certain shaft, all that is necessary is to pick up the shafting book, as it is called, and the desired information can be given immediately.

A glance at the sample sheet will show how much information is available. The date shows the time of doing the last work on this line, as the sheet is redated every time any change is made. The buildings are all lettered, each building retaining the letter marked against it on the sprinkler-system drawings. The floor and the side of the building on that floor where the shaft is are noted so that the mechanic sent to do repairs has no difficulty in locating the line immediately. Every line of shafting is numbered; no two lines in the entire plant have the same number. The motor driving the line is given the same number as the line of shafting it drives. This number is printed in type about 3 in. high on small pieces of cardboard, one of which is placed near the motor and one on each end of

Date 9-18-23

BUILDING A

FLOOR 1st SIDE South LINE 1

MOTOR SIZE 7½p SPEED 1165 R pm LOCATION Ceiling CONDITION New

MOTOR RATING Full Load 5.3 Amp PRESENT LOAD 6 Amp

MOTOR SWITCH Compensator MAKE G.E.

DIA. OF MOTOR PULLEY 5½" KIND Composition WIDTH 6"

MOTOR BELT Leather WIDTH 6" LENGTH 32'-8"

DIA. OF LINE SHAFT 1 15/16" SPEED 275 R P M LENGTH 24'

DIA. OF SHAFT PULLEY 24" WIDTH 8½" KIND Steel

NUMBER OF HANGERS 6 KIND Cast iron HEIGHT 18"

NUMBER OF COUPLINGS 1 KIND Cast iron

KIND OF MACHINES ON LINE Die cut, and grader

SIZE OF DRIVING PULLEYS ON SHAFT		KIND
1 #572	11" x 4½"	Wood
2 #571	10" x 6½"	"
3 #627	17" x 5"	"
4 #626	24" x 6½"	"
5		
6		
7		
8		
9		
10		

SIZE OF MACHINE PULLEYS		LENGTH OF BELT	WIDTH
1 #572	10" x 2½"	10'-6"	2"
2 #571	24" x 4½"	14'-10"	3½"
3 #627	24" x 4½"	14'-10"	4"
4 #626	26" x 6½"	15'-4"	6"
5			
6			
7			
8			
9			
10			

Loose leaf on which is recorded all the important data on machines and shafting

the line. In case of a countershaft driven by line No. 1, it is given the number 1A and a sheet is filled out for this countershaft. Motor size, speed, location and condition need no explanation. Motor rating and present load serve as a check against overloading the motor, and if it is necessary to put other machines on the line when the motor is fully loaded, it is at once apparent and a new motor can be ordered with the machine and be there when it is needed. Motor switch and motor pulley need no explanation. Width and length of motor belt are important items, as it is necessary to keep a supply of this belting on hand. Diameter of shaft and speed are, as previously stated, often called for by machinery agents and therefore most important to record. In case the motor is changed and the new one runs at a different speed, the diameter of the shaft pulley is needed, as this will have to be changed to suit the new conditions. Height of hangers limit the size of pulleys that can be put on the shafting and is therefore important to know. Kind of machines on line gives the character of the load on the motor and is necessary when deciding upon the type of motor. Every machine in the plant is numbered and in case it is desired to move any particular machine to another line of shafting or install a duplicate machine, the size of the driving pulleys and kind being known, it is a simple matter to figure out the necessary pulleys to be ordered. Width and length of machine belts make valuable data in keeping up the supply of reserve belting.

In handling this notebook one does not always have time to wash his hands before using, therefore some of the pages become soiled, but new ones can be quickly filled out with a fountain pen and inserted in their place. This should be done before the figures on the old sheets become too blurred to read. We find the notebook a time saver and a great help in keeping the power factor up and the running expenses down.

Rockland, Mass. BURTON W. WHEELER.

Keeping the Boilers on the Line with Plastic Firebrick

During the past year we had considerable difficulty with our boiler settings. Unfortunately the boilers are set three in battery and because of this the interior walls are hard to maintain. There have been times when the walls between the boilers would burn away in spots and expose the red brick that was used to back up the firebrick. The red brick would then melt out and flow over the dump plates in such a manner that they could not be dropped. This would usually result in a boiler shutdown. While the boiler was still hot the hole should be cleaned out and rammed with plastic firebrick. As a rule, this makeshift job lasted until a permanent repair could be made.

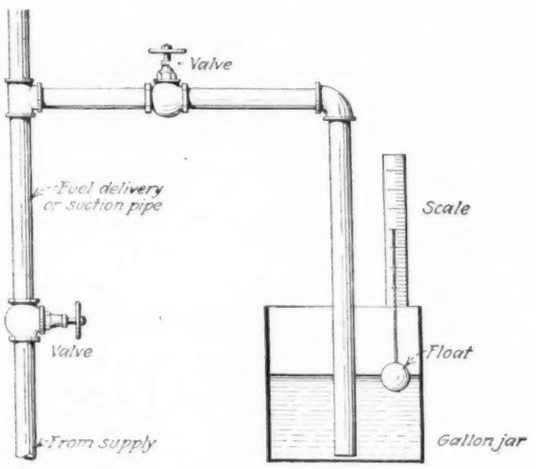
The permanent repair job was made as follows: After the setting had cooled off, the plastic firebrick plug was removed and the remainder of the wall was torn down. Starting below the grates, a new firebrick wall was constructed with alternate rows of stretchers and headers and bonded with high-temperature cement. As this wall was raised, the space in back of it was filled in with well-tamped plastic firebrick. This system was followed up to the tubes, and from there to the top plastic brick alone was used. The result was a firebrick wall backed with plastic brick. Great care must be taken in drying out the finished wall. It is our practice to place a small fire on the grates and keep it burning low for two or three days, the object being to drive the moisture out of the plastic brick as slowly as possible. Too hot a fire may produce steam, which will rupture the wall. At the end of the drying period the boiler is slowly brought up to pressure and put on the line. To date we have had good results with this method.

We have also learned that a lot of firebrick cutting can be avoided by using the plastic brick as a filler in spots that are hard to reach with regular firebrick.

Monroe, N. Y. R. C. WHITEHEAD,
Superintendent of Power,
Orange & Rockland Electric Co.

Checking Oil Consumption

In the illustration is shown an arrangement by which one can find how much fuel can be saved by different changes in an oil-engine plant. By means of such a gage one can find just how to run the engine with the greatest efficiency. The correct lubrication and lubricating oil can also be found. For example, to find the loss due to misaligned shafting, measure the amount of oil used for, say, one hour. Then clean all bearings in the plant and line up all shaftings correctly. Now make another test, and one will be surprised how much fuel will be saved. One can also find out how much more a tight belt costs to run than a slack belt, or how much less power ball bearings on the line shafts will save over ordinary bearings, etc.



Gage to measure efficiency of oil engines

Usually oil engines have small tanks in the engine room for warming up heavy fuel. These tanks generally hold a day's supply, and if they are vertical they can be measured and a scale made. For instance, every inch of tank might hold 1 gal. of oil. If the total fuel required for the day's run is wanted, the tank should be measured at the start and stop of the run.

Unless we know the power costs, we do not know what we are doing. From the sketch it will be seen that all the auxiliary needed is a pipe with a valve fitted into the main fuel-supply line. The pipe is extended to the bottom of a gallon measure. In the measure is placed a rule marked in inches and quarter inches. By calibrating the jar the oil per inch is ascertained.

Raley, Alta., Canada. J. J. WALTER.

Comments from Readers

"Gearless" Reduction Gear

In your issue of March 2 is an account of a "gearless reduction gear" invented by Lewis Burn. Anyone reading this article would get the impression that a new principle is involved here, but such is not the case. Although I know of no previous application of this device, the mechanism has been described in various publications. For example it is shown in the 1910 edition of Dunkerley's "Mechanism."

I do not wish to criticize the article, which is a very good explanation of a rather curious device. I simply wish to correct the impression that this is a new mechanism.

JOHN A. DENT.

University of Kansas,
Lawrence, Kan.

Overmotoring Not Caused by Power Companies' Rules

As a constant reader of your valued publication, *Power*, I am taking the liberty to write to you regarding an editorial on overmotoring which appeared in the March 2 issue. The third paragraph, which reads: "Some of the power companies have rigid restrictions," etc., implies that the power companies are imposing undue restrictions upon motor installations by limiting starting currents. This is not in accordance with facts, since the starting currents which most companies do permit are those values which were agreed upon with the manufacturers some years ago as being reasonable and feasible limitations covering the use of the so-called general purpose motors, throughout the various industries. The values were later incorporated in the N.E.L.A. Motor Rules.

It has been stated that the rules now in effect governing starting currents actually induce overmotoring, but long experience in dealing with motor installations leads me to suggest that this is actually an impossible view, except in isloated cases.

It has been noted that manufacturers of certain apparatus have taken such a course in a few instances, but such cases have been the exception rather than the rule.

In ordinary motor purchases it can be truthfully said that the customer knows nothing about starting-current limitations, since he is buying a motor of a stated horsepower capacity. It is only when the installation has been made that the starting-current problem develops, and so far as the writer is aware, on a very large system with which he is connected, the question of starting current values has arisen in but few cases among many thousands of applications over a period covering the last twelve years.

It cannot be successfully contended that a customer in his right mind would deliberately purchase a motor larger than he really needed solely on account of starting current, about which he knows nothing as a matter of personal experience.

The entire aim of our utility interests has been to induce customers to purchase motors closely approximating their requirements, with, however, a full recognition of a limited number of cases where a customer insists upon purchasing a motor too large for his immediate use in order to have some capacity to grow to as his business increases.

It must be remembered that a customer deliberately purchasing a motor in excess of his requirements, which creates a lower power factor than a company is willing to supply, usually results in the customer being penalized for such indiscretion through the company's rates covering such situations.

It therefore seems unfair to suggest that the power companies are contributing to overmotoring through their starting-current requirements, when the reverse is actually the case. It also seems necessary when discussing this subject to consider the difference between large and small systems and to recognize the right of the smaller systems to prescribe starting-current rules that are necessary to meet their local conditions without in any way prejudicing the attitude of the industry as a whole.

As between auto-starters and other methods of starting, it is true that systems of small capacity frequently require the use of slip-ring motors where their distribution systems will not stand the fluctuations caused by the auto-transformer type of starting equipment. This, however, is a local condition which does not contribute unfavorably to the customer's interest, and is in the same class with the resistance starters which have been mentioned in the editorial.

You will appreciate that there is no contention being offered regarding the excellent results to be secured by resistance-type starters, since this form of starter is welcomed by every power company as one of the more recent developments which will result in better motor installations.

G. E. MORGAN.

Boston, Mass.

Separating Pipe Flanges to Insert Gaskets

In the Dec. 29, 1925, issue a device for separating pipe flanges to insert a new gasket was illustrated and described. I fail to see how the little clearance a device of this kind would give would permit a workman to chisel off the old gasket from the flanges. In the first place a chisel could not be entered, and, if it could be, it would have to be held at such an angle to the face of the flange that it would be impossible to clean the faces of large flanges.

The main headers in two of our boiler plants are made up of 16-in. pipe and fittings, the flanges being 25½ in. outside diameter. Whenever a sheet packing joint fails and has to be remade, we use the following method of cleaning the face of the flanges: First, the pipe or fitting is supported on each side of the joint and the bolts are removed. Then the cleaning of the joint is done with a carpenter's hand saw by sawing

down between the flanges; this cleans both flanges at the same time. The saw is slightly thinner than the gasket, so no separating is required.

Norway, Mich. THOMAS PASCOE.

The Hydrostatic and Hammer Test for Boilers

I have been much interested in the discussions that have appeared recently in *Power* on "The Hydrostatic and Hammer Test for Boilers." Personally, I believe in the use of both tests whenever the conditions demand it. The purpose of putting a hydrostatic test on new boilers as well as old ones is not simply to subject the boiler to a pressure considerably above the normal working pressure but to show any leakage at tube ends, seams or rivets which no trained inspector or engineer could detect with the eye. In new boilers this pressure is carried from one and a half to one and three-fourths times the allowable working pressure, and the boiler should withstand the pressure without injury in order to be safe to operate at the pressure for which it was built. In old boilers the plates may be reduced in thickness considerably from erosion and corrosion, and in such cases the hammer and scraper test will disclose many defects which the hydrostatic test does not, such as fire cracks on furnace sheets or flues, thinning of water leg plates near the mud rings or around staybolt ends on the firebox side, where in some instances it has been possible to thrust the blade of a small knife through the plate beside the head of a staybolt even after the hydrostatic test had been applied.

In the old days the inspectors endeavored to make a thorough examination of all boilers by taking particular care to use the hammer on all rivets holding brackets on return-tubular boilers. This could be done only from the inside. In one case I recall a rivet head was discovered to be loose when tapped with the hammer; though hydrostatic pressure did not disclose any leakage. The brickwork was removed from around this bracket and it was found that the rollers had rolled from under one edge. This put all the weight on one side of the bracket, with the result that two of the rivets were sheared and a corner broken off the bracket. This is a good example of what can be disclosed by the hammer test. The shearing of the rivets in this case was partly due to the old process of punching and drifting the rivet holes to make them match and is not so common today where the holes are reamed out to receive a full-size rivet. Thin plates are readily detected when tapped with a hammer, and when there is doubt about their thickness they should be drilled through with a small drill in order that the thickness may be accurately determined. I am surprised there is not more of this drilling done today. It was an old custom in marine service some years ago.

I do not believe in applying to an old boiler a higher hydrostatic test than the steam pressure for which the safety valve is set to carry. In one case where a boiler was given a hydrostatic test, the safety valve had been removed and a blank flange bolted on. An old duplex feed pump that would only run fast or not at all was used to give the necessary pressure. The pressure was finally raised to a little over 100 lb. as indicated by the gage on the boiler and was allowed to stand there while the boiler was examined for leakage. After about 30 minutes the valves were opened, the pressure was lowered and the boiler was emptied and opened up. Upon inspection it was found that one of the radial braces was broken at the fork, another had the holes in the end of the fork stretched out to a breaking point as disclosed by a crack in it and a brace on the other end of the boiler had two pins which held them to the T-iron on the head pulled out in a U shape. No record had been kept of this boiler except that at the office of the builder, which on investigation showed it to have been built for a working pressure of 65 to 80 lb. and had been in service several years.

It is well to know the size, number and kind of braces or stays and the allowable stress they may sustain before applying a hydrostatic test, and be sure that the pump used is suitable for the purpose, as a slight increase in the speed of the pump at the critical moment when the pressure reaches the limit allowed may, as in this case, put an overpressure on the boiler. Whether all of the damage in this case was due to the gage being out of order and the excess pressure from the pump is still in doubt, as the gage mechanism was badly sprung when examined and a new gage had to be obtained. When hydrostatic tests are made, two or more pressure gages should be used, especially on old boilers. Much damage has been done to old boilers by hydrostatic tests, and when cracks occur in boilers under test after they have been in service many years, it is an indication of crystallization of the plates, and the pressure should be reduced to a safe point or the boiler scrapped. R. A. CULTRA.

Cambridge, Mass.

Burning Low-Grade Coal

In the Feb. 23 issue of *Power* there appeared a letter by C. B. Hudson on the burning of low-grade coal, in which he discusses the heat losses due to water vapor resulting from the combustion of hydrogen contained in the fuel. Mr. Hudson states that the superheated steam resulting from the burning of hydrogen is "at approximately atmospheric pressure" and that it will be necessary to cool the gases and the steam "to 212 deg. or slightly less" to produce condensation and to cover the latent heat.

This is not correct. The actual partial pressure of this water vapor in the flue gas mixture is of the order of 2 or 3 lb. per square inch absolute, and its condensation will not begin until the temperature has been reduced to perhaps 140 deg. F. In other words, the relative humidity of the flue gas is less than 100 per cent at ordinary flue temperatures, and the dew point of the gas mixture is in the neighborhood of 140 deg. F. Above this temperature no condensation will occur.

Continuing his incorrect assumption, Mr. Hudson calculates the heat that would be developed by the condensation of the water vapor in the flue gas, on the assumption that this is superheated steam at atmospheric pressure. This is incorrect. A correct and very simple method of making this computation was presented in an article in *Power* for March 17, 1925, on page 410. It is shown in that article that the total heat of low-pressure steam, for any pressure below 5 lb. per square inch absolute, is given to the nearest single B.t.u. by the formula $H = 1{,}057 + 0.46t$.

If, therefore, a flue gas mixture were cooled to, let us say, 70 deg. F. from an initial temperature of 500

deg. F., the heat developed by the cooling and condensation of the water vapor would be approximately as follows:

$$Q = [\textit{total heat of vapor at } t_1 \textit{ deg. F.}] - [\textit{total heat of liquid at } t_2 \textit{ deg. F.}]$$
$$= [1{,}057 + 0.46t_1] - [t_2 - 32]^*$$
$$= [1{,}089 + 0.46t_1 - t_2]$$
$$= 1{,}089 + 0.46 \times 500 - 70$$
$$= 1{,}249 \textit{ B.t.u. per pound of water condensed.}$$

In the case assumed by Mr. Hudson he considers the gases to be cooled from 500 to 200 deg. F. Inasmuch as the dew point of the gases is almost sure to be less than 200 deg. F., none of the water vapor will be condensed in this process, and therefore the heat recovered will be much less than that calculated by Mr. Hudson, being in fact simply the weight of steam, multiplied by the specific heat, multiplied by the range of temperature, which gives $0.11 \times 9 \times 0.46\ (500 - 200) = 136.6$ B.t.u. per pound of vapor.

It must be remembered that formulas cannot be used with safety without an understanding of their meaning. To use any formula for the heat that would be recovered by cooling flue gases to 200 deg. F., on the assumption that this cooling will condense all of the water vapor present, is incorrect. Of course the formula gives a numerical result, but this does not represent the heat recovered, because cooling to 200 deg. F. will not condense any of the water vapor whatever, and therefore the heat lost or recovered, as calculated by the formula, will be around 1,000 B.t.u. too large for each pound of moisture present. JAMES A. HARRIS.

New York City.

In his comments on Mr. Sheehan's article on "Burning Low-Grade Coal," C. B. Hudson says he has always understood that the hydrogen content of any fuel is a detriment rather than an advantage due to the fact that the hydrogen unites with the oxygen furnished for combustion, the resulting product being H_2O or water, which exists in the furnace as highly superheated steam.

He then goes on to demonstrate that unless this superheated steam in the gases is condensed, "the loss in the furnace due to the combustion of the hydrogen will be approximately 6 per cent."

This involves the much-discussed question of the use of the high- or low-heat value in considering boiler performances, but does not prove that hydrogen in the coal is a detriment from the heat value point of view.

Suppose the fuel were all hydrogen. Under the conditions assumed in Mr. Hudson's example, the products of combustion would carry to the chimney 10,057 B.t.u. in the superheated steam and 1,912 in nitrogen, or 11,969 B.t.u. in all.

Out of the 62,000 B.t.u. generated by the combustion of a pound of hydrogen, this would leave 62,000 — 11,969 = 50,031 B.t.u. available.

Suppose the fuel were all carbon. Under the same conditions the products of combustion would carry to the chimney 876 B.t.u., which would leave only 14,500 — 876 = 13,624 B.t.u. available per pound of carbon, as against 50,031 per pound of hydrogen. From this point of view, then, the more hydrogen the fuel contains at the same price per pound as carbon the better.

This is simply from the heat unit point of view. I am not discussing the difficulties of burning high-volatile fuels. P. J. JENKINS.

Malden, Mass.

Why Not a True Comparison of Public Utility and Industrial Power Costs?

It is difficult to compare power costs without a knowledge of the various items entering into the total, which in the case of the central station includes fuel, oil, waste, repairs, labor, insurance, taxes, management, distribution, maintenance and depreciation. The size of plant, load factor, variation in load, ratio of maximum load to economical full load, number of days the plant is operated, etc., must be known to make a true comparison. A distinction must be made between the cost at the generating station busbars and that when delivered to the customer. In the former case, it should be based on only such portions of the charges and expenses as are applicable to the generating station, whereas in order to obtain the cost of power delivered, the total expenses must be considered; and to this must be added a profit.

What can be done, however, is to compare the general average cost of public service power, as at present sold and delivered, with the production cost of industrial power. One hears a great deal of how cheaply the public service plant can generate power and also at what price it is sold compared with an industrial plant power cost. In many cases, particularly small plants, it is true that this power can be furnished at a lower rate than it costs the industrial plant to generate it. Much, however, depends upon the type of the industrial plant and its relative demands for power and process steam. When byproduct steam is used for manufacturing purposes or heating, or when hot water is required for processing, the cost of industrial plant service will, in most cases, be decreased greatly in comparison. In comparing central-station and industrial-plant power, the total operating costs are seldom considered.

One of the present needs is to get at the facts as to power costs. It has not been the general practice to publish total cost data, but why should the engineering profession be made the loser because of this? Perhaps, if this were done, unwarranted attacks against utilities might be lessened. Knowledge of the performance in B.t.u. per kilowatt-hour of public utilities plants adds little to the cost knowledge, as a lower B.t.u. per kilowatt-hour may be obtained at a higher final cost. Part of the current produced goes into the plant itself and considerable is lost in distribution, so that the actual cost should be figured on the kilowatt-hours sold. In a public-service plant not much more than 80 per cent of the power generated is delivered to the customer; the remainder is lost. In New York City, for the year 1924, there was a loss from generation to sales of 1,504,792,341 kw.-hr., or nearly 20 per cent, which, of course, cost money for production. There is too much spread between 1c. and 8c. or 10c. per kilowatt-hour. A sliding scale of rates, depending upon the energy used, or for off-peak power, is justifiable, but public service corporations sell power in large blocks at rates that in many cases are lower than it can be manufactured, were all items included. The deficiency, in the writer's opinion, should not be made up by higher rates charged small consumers.

*For temperatures up to about 250 deg. F., $t - 32$ approximates the total heat of liquid water to the nearest single B.t.u.

From fifteen steam-driven public-service plants I have obtained figures that show that the current sold per year was 1,453,924,986 kw.-hr., at a total operation expense of $31,111,130. This makes the actual reported cost per kilowatt-hour of sold current 2.14c. The production cost of one of the largest electric utilities in New York for 1925 was 3.6c. per kilowatt-hour, according to testimony before the Public Service Commission. Although this figure may be thought high, I believe that for the average central station, with all costs taken into account, it will not be below 2c., and this figure rarely appears in reports. It is probably higher than this in New England. In 1922 an analysis was made of the cost of steam electric power in the important central stations in New England. This showed that the average production costs, not including fixed charges, was 0.95c. per kilowatt-hour, and the average price to the customer, which included fixed charges, distribution costs, losses and profits, was 3.54c. per kilowatt-hour.

In 1919 the average actual annual production cost of steam-electric central stations in the superpower zone was 1.56c. per kilowatt-hour at the station busbars, exclusive of distribution expenses, fixed charges and overhead. A public-service plant has to carry all the charges and profits of a business organization and its manufactured product is power. An industrial plant is only a part of a larger industrial organization and charges against it are only those properly included in the generation of the power to manufacture the finished industrial product. In the industrial plant operation, the following expenses included in the public-service operating costs are eliminated: Transmission and distribution, utilization charges on customer service, new business, commercial expenses and business overhead expense.

We can safely assume, therefore, that even when the operating costs are considered, an industrial plant furnishing current for 2½c. to 2½c. per kilowatt-hour would be on an equal basis actually with a public-service plant.

In many cases there is opportunity for an advantageous exchange of power between industrial plants and public-service plants at certain times or between two or more industrial plants. Sometimes a combination of purchased and industrial power is more economical than either alone. Although it is possible, under existing regulations, for power companies to make low rates in order to increase their load factor and for other reasons, many industrial plants can compare favorably when all costs are taken into consideration, especially those having a process-steam demand. The average yearly load factor of large public service stations will not greatly exceed 45 per cent. The average of all would be much less. It is questionable if this can be increased to any appreciable extent under our present system of industrial and home life. Stations may operate on a base load, giving perhaps better economy, but when this is done, the load on other stations must be less, for the national load factor is bound to remain much the same.

I should like to hear actual cost figures discussed at some meeting. If real engineering is to be advanced, true comparisons must be available. We are more or less groping in the dark, each trying to gain financial ends without coming together along the one line of producing the cheapest possible power. A designing engineer must apply all the economic factors; if he does not, he cannot design the most economic plant for the given purpose. It would be a decidedly useful thing if there were a standard classification in power-station accounting and cost figures, brought out, preferably, by a properly selected and unbiased committee. This would be a rather difficult thing to do unless there were favorable co-operation on everybody's part. Almost all scientific and technical information issued by engineering societies is desirable and advances true engineering. B.t.u. comparisons are interesting and discussions of improved equipment to effect power economy are instructive, but unless we can get at the real basic thing, the question of actual power costs, we shall always be working in the dark.

The foregoing is written with no idea of restricting the economical use of purchased power. Central-station plants have been the forerunner of engineering improvements, affecting the economical operation of boilers and turbines. They are an asset and a valuable industry for the community and the nation. They have stood the brunt of engineering improvement and design for the last twenty years. Interconnection of plants will help some in the economical use of current. What I do want, however, to bring out strongly is the question of costs. Comparisons between plants should be made only when all costs in connection with the production of power are considered. If this is done, it will be found that there is a marked difference between the costs often used as a comparison and the actual costs.

Manchester, N. H. WALTER G. DIMAN.

The Centrifugal Pump and Its Applications

Replying to the letter of Allen F. Sherzer in the Nov. 24, 1925, issue commenting on my previous articles on "The Centrifugal Pump and Its Applications," and in which he criticizes me for setting forth a method of selecting a pump adapted to the pipe line instead of fitting the pipe line to the pump, I still maintain that my method is right for the problem as stated. That my method is justified in certain cases will be clear from the following.

A mine superintendent near here who has charge of a camp of mines on a hill about 400 ft. above the Monongahela River asked me to figure on a multi-stage centrifugal pump to replace a triplex-plunger pump that was being used to supply water for the camp. The water was pumped through 1,300 ft. of 2½-in. pipe at the rate of 40 gal. a minute.

The triplex pump is started and stopped by a float on the tank, and owing to the labor situation it is difficult to keep it in repair. The result is that the pump, which ordinarily should be an efficient unit, is working at a great disadvantage and is wasteful of power. On account of this waste of power and also because of too frequent breakdowns, I was asked to figure on another type of pump.

Now it is evident that this superintendent is seeking, not so much efficiency in itself as economy of operation. This is a situation that I tried to point out in my article on pipe-line efficiency. The line is in. The tank is in. The pump capacity is not fixed by other considerations. (Of course, it must not be too small.) I told him he would benefit by operating at increased capacity. "Yes, but I don't want to run my pipe friction too high," he replied.

There is the essence of the situation. I knew that

a centrifugal pump is inefficient when operating at too small capacity. He was thinking only of pipe-line losses when the capacity is too great. It is a method of finding a balance between these two extremes that I tried to point out in my original article.

With reference to the other article, "Side-Suction Centrifugal Pumps More Efficient for Small Capacity," which was referred to, I find data on this point extremely scarce. However, what data I have point clearly to the facts brought out regarding side-suction pumps. I have corresponded with several pump manufacturers in regard to this, and they did not have any tests that would bear weight either way. All that I have are two tests that I ran myself before writing the article.

Pittsburgh, Pa. RUSSELL K. ANNIS.

How Are Slush-Ice Troubles Handled?

Recently the State of Colorado installed and put in operation a one-unit 250-kw. hydro-electric plant, which is to supply lighting and heat for the state prison. This station is now in operation at full capacity. During the cold season of this year it was rendered inoperative, because of the slush ice lodging in the racks, therefore cutting off the water to the penstocks and causing them to freeze solid. This plant operates at a head of 12 ft. and at full load requires about 250 cu.ft. of water per second. I should appreciate hearing from hydro-electric plant operators who have such problems to deal with, as to how they combat these troubles.

Canon City, Colo. JOHN J. WILLIAMS.

Exhaust Steam Versus Live Steam for Heating Purposes

I do not know what Mr. Smedley means when he says on page 425 of the March 16 issue that steam when exhausted from an engine cylinder should be practically motionless and that it is its velocity due to expansion that makes the engine go. This, referring to mass velocity, is true of a turbine but not of a displacement engine. Referring to molecular velocity, it is true of the piston engine, for it is the impact of the molecules that produces the pressure that drives the piston; but there is still a lot of molecular velocity left in exhaust steam.

He says that in addition to being practically motionless the steam should be very much wetter than when it entered the cylinder. In this he is right. The more of its heat that has been converted into work the wetter it will be. But it is not a fact that exhaust steam is always full of moisture.

Take an engine using 135 lb. gage (150 abs.) steam, dry saturated, exhausting at 25 lb. absolute. The total heat of 150 lb. dry saturated steam is 1,193.4 B.t.u. per pound. To make 30 lb. would require $30 \times 1{,}193.4 = 35{,}802$ B.t.u. Of this, 2,545 B.t.u., the heat equivalent of a horsepower-hour, is converted into work, leaving, neglecting radiation, $35{,}802 - 2{,}545 = 33{,}257$ B.t.u. to be exhausted.

The total heat of 1 lb. of dry saturated steam at 25 lb. abs. is 1,160.4 and of 30 lb. $30 \times 1{,}160.4 = 34{,}812$ B.t.u. Of this $208.4 \times 30 = 6{,}250$ is heat of the liquid, leaving $34{,}812 - 6{,}250 = 28{,}562$ necessary for its evaporation.

Of the 33,257 B.t.u. coming out with the exhaust $33{,}257 - 6{,}250 = 27{,}007$ will be available for such evaporation, so that the steam will be $27{,}007 \div 28{,}562 = 94$ per cent dry.

If the steam were originally superheated 90 deg. instead of being dry saturated, the exhaust would contain no moisture, again neglecting radiation.

With the high pressures and superheats now carried, the exhaust of small turbines is often considerably superheated. WALTER STANLEY.

Cleveland, Ohio.

Boiler-Water Level Drops

The query on "Boiler-Water Level Drops" in the Jan. 19 issue and the answers in the March 9 issue interested me considerably, because I have had practically the same experience with a large sectional boiler.

The answers in the March 9 issue have just about hit the nail on the head. Undoubtedly what happened was the water, surging back and forth through the check, dislodged any particles or sediment that kept the valve from seating. It is possible, of course, that someone else opened the stop valve and thus equalized the pressure on the return line so that the water returned to the boiler.

In my case I found that upon shutting off the stop valve the steam pressure started to build up rapidly, and the water to disappear. There was no steam leaving the boiler from any point, so the only place to look for trouble was in the return line. I took apart both the check and the gate valve on the return line. In the check I found about two handfuls of scale and sediment carried down from the radiators and pipe-coils, and about the same in the bottom of the gate valve. After removing the sediment and grinding the check valve in, I had no more trouble. I might add that this boiler and heating plant were less than two years old when this occurred. J. V. ELSWORTH.

Watertown, N. Y.

Costs of Power

The March 2 issue carried two especially interesting and valuable articles, one on the New York Edison statement of costs and the other on the Holyoke municipal plant. It seems incredible that in the former case, dividing the total annual cost by the total kilowatt-hours sold brings a cost over 3c., and equally remarkable is the same method applied to Holyoke, which brings a cost only slightly over 2c. Besides that, Holyoke redeemed $66,000 worth of bonds, which would further reduce the cost.

Moreover, the cost per kilowatt of the apparatus listed in the new Holyoke extension runs less than $60, inclusive of coal pocket and railroad siding, but not including building.

These are remarkable figures, and probably explain why Holyoke can retail current at 5c., supply it to the city at 4c., sell power at 1½ to 2 c. and still show a good profit annually. It is not so easy to understand how the New York Edison Co. can sell current for 1 to 1½c. when its cost is over 3c. W. G. STARKWEATHER.

Boston, Mass.

[The list of apparatus and contract prices given in the article on the Holyoke plant referred to in the foregoing is not complete, the principal items only being given.—EDITOR.]

A new slant on things observed in and out of the power plant

What Happens and Why?

The Air Lift

Water seeks its own level, runs the old saying. In most cases this is true, but water does not always seek its own level, and this fact has been utilized in a practical way to develop an important system of pumping—the air lift.

The principle of the air lift is easily understood by studying the accompanying sketches. In Fig. 1 *A*, *B*, *C* and *D* are glass tubes filled with water or combinations of water and kerosene. Where water alone is used, as in *A*, the level of the water will be the same in both branches of the tube. The same, of course, holds for *B*, which is like *A* except that the level of the water has been lowered to make possible a certain experiment. This experiment is as follows:

Take some kerosene having a density of 0.80—that is, weighing 80 per cent as much as the same volume of water—and pour it gently down the right-hand branch until a layer 1 in. deep has accumulated above the water, as shown at *C*. It will now be found that the surface of water in the left branch is below that of the kerosene. Measuring up from the water level in the right branch, it will be found that 0.8 in. of water is balancing 1 in. of kerosene. (The water columns below are equal and automatically balance each other.) This is natural when one stops to think of it, because with its greater density 0.8 in. of water must weigh the same as 1 in. of the kerosene.

The experiment can be continued by pouring in more kerosene until it is 5 in. deep in the right branch, as shown at *D*. Measuring up from the bottom of the kerosene, the water in the left branch will now stand 4 in. The water height is still eight-tenths of the kerosene height.

To make two columns of water balance with the surfaces at different levels, it is necessary to lighten the water in one column in some manner or other. This can be done by blowing it full of air bubbles. In Fig. 2 *A* shows the apparatus necessary for performing an experiment of this sort. Before air is blown into the right-hand branch the level will be the same in both branches. In *B* air is blown into the right branch at such a rate that the original top 4 in. of water is expanded to 5 in. This expansion is accomplished without any increase in weight (neglecting the weight of the air bubbles). A 4-in. column of solid water is balancing a 5-in. column of foamy water of the same total weight.

A diagrammatic representation of an actual air lift is shown in Fig. 3. Here the central pipe corresponds to the right branch in the model, and the surrounding space in the well corresponds to the left branch. When no air is delivered, the level inside the pipe will be the same as that outside. Let us assume that both stand 60 ft. above the air nozzle. If now air is blown in at such a rate that the same weight occupies 100 ft. of height (which is the same as saying that the mixture weighs 60 per cent as much as solid water), the water in the central pipe must rise 100 ft. above the nozzle in order to balance that in the well. It will then overflow to the outlet pipe. It is evident that the submergence of the nozzle is an important factor of efficient operation.

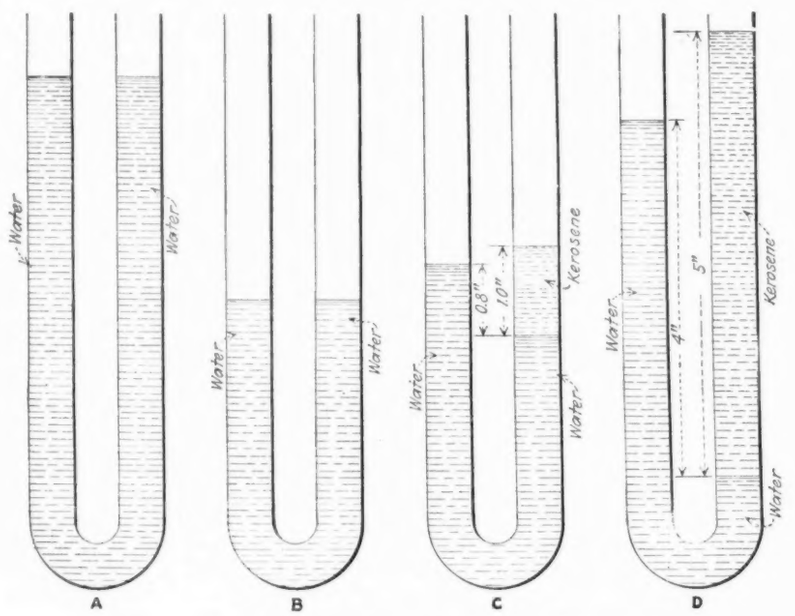


Fig. 1—Experiments on balancing columns of liquid

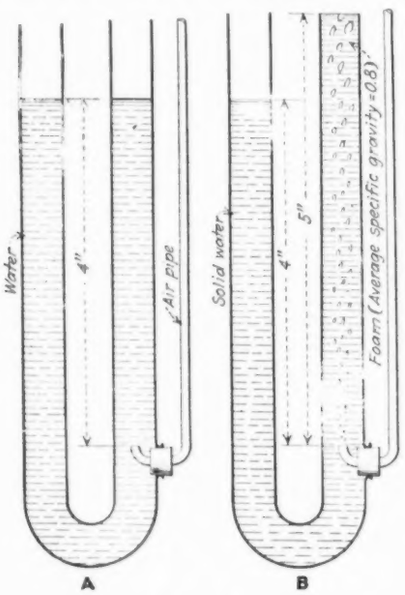


Fig. 2—Model shows principle of the air lift

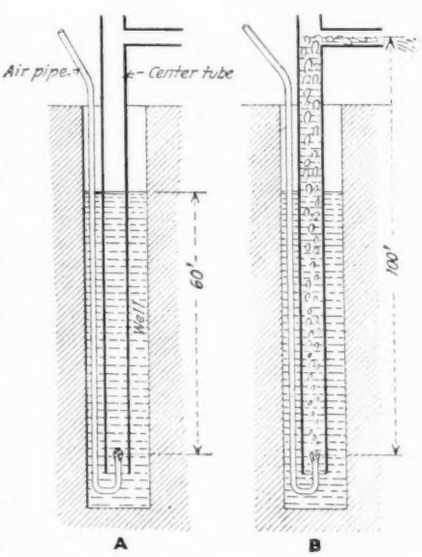


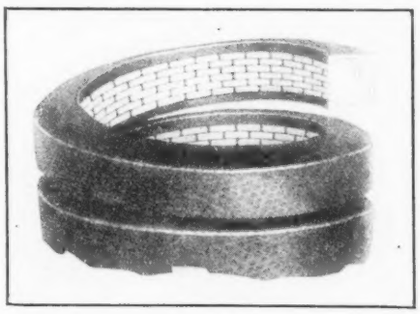
Fig. 3—Diagrammatic representation of air lift

New and Improved Equipment

New Garlock Metal-Filled Packing

A type of metal-filled packing designed for use on piston and valve rods and other services where high steam pressures are encountered has been brought out recently by the Garlock Packing Co., Palmyra, N. Y.

The packing has a wearing surface of soft metal inclosed on three sides by a covering of asbestos and rubber. The metal filler in the channel of the packing is of special design and is perforated and cut to fit the various sizes of



Metal-filled high-pressure packing

rod. The design of the filler is such that it tends to hold a large percentage of lubricant and for the sections or studs to seal one another against the pressure.

New Carbon Monoxide Recorder and Alarm

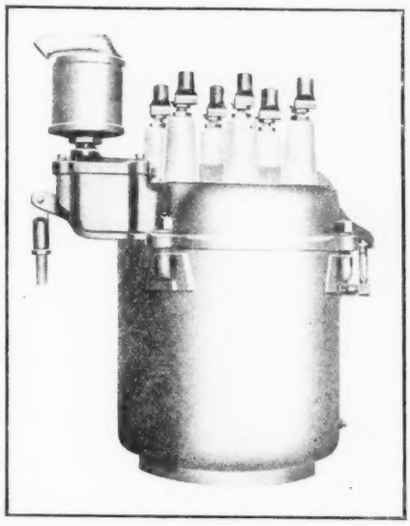
Ability to record variations as small as two parts of carbon monoxide in a million is claimed for a new carbon monoxide recorder and alarm developed by the U. S. Bureau of Mines and described in Technical Paper 355 of the bureau.

This instrument was developed primarily to protect the lives and health of passengers in vehicular tunnels, such as that at Pittsburgh or the new tunnel from New York City to New Jersey under the Hudson River. It has been found that anything more than four parts of carbon monoxide in 10,000 parts of air is likely to produce noticeable effects in a person exposed for one hour. The instrument is sensitive to less than 1 per cent of this concentration.

The air to be tested is drawn past the "cold" junctions of thermocouples buried in pumice and then past the "hot" junctions buried in granulated hopcalite—a mixture of manganese dioxide and copper oxide. This mixture was developed during the World War for use in the canisters of gas masks. When carbon monoxide passes through hopcalite along with oxygen, the oxygen unites with the carbon monoxide to form carbon dioxide. The burning of CO to CO_2 in this manner produces heat, although the resulting temperature rise is necessarily very small with the small concentrations measured. However, the extreme sensitivity of the thermocouples makes this measurement relatively simple.

Multipole Oil Circuit Breaker with Single Tank

One of the features of the new multipole oil circuit breaker of the Westinghouse Electric & Manufacturing Co. is the inclosing of the three poles in a single round tank. This arrangement is to give the breaker increased rupturing capacity and increase the electrical clearance between the terminal connections, with small space requirements. The single circular tank with domed bottom and top resembles



Oil circuit breaker completely assembled

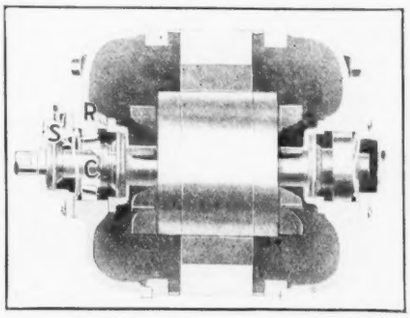
boiler construction to give strength for resisting internal pressures.

The domed frame permits using space, heretofore not utilized, about the contact studs for additional volume in the air-expansion chamber above the oil, and also allows the system of operating levers to be inclosed within the breaker chamber, all without increasing the over-all height of the breaker.

A main shaft, brought through the frame, with a single operating lever outside and well away from the live terminal connections, and the remainder of the levers within the breaker, result in the removal of grounded moving parts from the vicinity of the bus connections. By this means the air-insulating distances outside the breaker are increased and an oil-tight structure obtained. The single round tank for all poles provides for the efficient use of the oil, the insulating properties of the entire volume of oil being available for each pole. This construction also simplifies such maintenance features as renewal of oil, maintaining the oil level and the inspection of contacts.

Automatic Recentering Bearings for Electric Motors

It has been stated by practical operating men of alternating-current motors that 95 per cent of motor troubles may be traced to the bearings. Many of these troubles are the result of bearing wear so as to allow the rotor to rub on the stator. In order to in-



Cross-section of motor, showing the bearing construction

sure a continuous uniform air gap in motors, the Howell Electric Motors Co., Howell, Mich., has brought out a line of motors with anti-friction bearings, in which any looseness in the bearing, caused by wear or otherwise, is automatically taken up, so as to keep the rotor centered and thus maintain a uniform air gap. This is accomplished by the use of a Timken tapered roller bearing, shimmed with a fluted wire spring, which acts as a compression spring, as shown in the figure.

The inner race or cone *C* of the bearing is fitted on the shaft with a light press fit. The outer race *R* is fitted into the bearing housing with a sucking fit that allows creeping of the outer race. The spring *S* is held tightly against this outer race by the grease cap pushing the race against the rollers and keeping the bearings tight at all times. This type of bearing is put in each end of the motor and keeps the rotor automatically centered, and the bearing does not need to be adjusted for wear or any other looseness. The spring allows for any lateral expansion of the shaft that might occur due to heat.

These bearings are arranged for grease lubrication, and effective seals are used to keep the grease in and to keep out foreign matter, such as dust, dirt or abrasives. The motors can be mounted in any position without changing the end bells. They will operate in any vertical position as well as horizontal, as these bearings have a thrust capacity equal to their radical capacity.

Meetings Scheduled for Oil and Gas Power Week April 19 to 24

These meetings are to be held under the auspices of the various National Technical Societies and include those announced up to April 6

CALIFORNIA

San Francisco—April 22, 7:30 p.m., Engineers Club, 57 Post Street, following a dinner. Subject: Development, Design and Construction of American Double Acting Diesel Engines, by V. A. Stout, Worthington Pump & Mchy. Corp. Meeting of A.S.M.E. San Francisco Section, with participating locals invited.

COLORADO

Denver — April 20, 8:00 p.m., Odd Fellows Temple, 6th Floor. Subject: Paper on Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. Meeting of N.A.S.E. No. 1.

CONNECTICUT

Meriden — March 11, Home Club. Subject: Gasoline Railway Cars, by F. A. Keihn, The J. B. Brill Company, Automotive Car Division. Meeting of A.S.M.E. Meriden Section.

New Haven — April 24, 8:00 p.m., Room 25, Gamble-Desmond Building, 890 Chapel Street. Subjects: Sources of Oil, by W. R. Schurk; Methods of Firing, by H. J. Rathgeber; Advantages and Disadvantages of the Use of Oil, by M. VanderVeer; Comparison with Coal, by E. E. Thomas. Meeting of N.A.S.E. No. 10, with all locals invited.

Waterbury — April 20, 8:00 p.m., Mattatuck Hall. Subject: Diesel Motors, by Harte Cooke, Engr., McIntosh & Seymour Corp., Auburn, N. Y. Meeting of A.S.M.E. Waterbury Section and N.A.S.E. No. 15.

DELAWARE

Wilmington — April 24, 8:00 p.m., Eden Hall. Subjects: Use of Oil Engines in Shovels, Locomotives, Dredges and Other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp; The Daily Duties of a Diesel Engineer, by M. L. Black; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell. Meeting of N.A.S.E. No. 1.

DISTRICT OF COLUMBIA

Washington — April 22, Dinner at Cosmos Club at 6:30 p.m. Meeting at 8:00 p.m., Cosmos Club (Assembly Hall Entrance on Madison Place). Subjects: Researches in Petroleum, by Wm. Taylor Thom, Jr., of Geological Survey; Conservation of Petroleum, by Julian D. Sears, of Geological Survey; Research on Oil-Injection Engine for Aircraft, by Wm. F. Joachim, Langley Mem. Aero. Lab.; Fuels for House Heating, by Prof. Julian C. Smallwood, Johns-Hopkins Univ. Joint meeting of U. S. Geological Survey, American Engineering Council, National Research Council, American Mining Congress, U. S. Bureau of Standards, A.S.M.E. Washington, D. C. Section, A.S.M.E. Student Branch of Catholic University. All participating organizations invited.

ILLINOIS

Chicago—April 17, Room 309, Capitol Building (Corner State and Randolph Streets), 7:15 p.m. Motion Pictures, 8:15 p.m. Lecture. Subject: Application and Operation of Diesel Engines, by G. A. Adkins, Fairbanks Morse and Company. Meeting of N.A.S.E. No. 28, with co-operation of A.S.M.E. Chicago Section. All locals invited.

April 21, 8:00 p.m., Room 309, Capitol Building. Subject to be announced. Meeting of N.A.S.E. No. 1.

Joliet—Meeting of N.A.S.E. No. 11. Subjects: Papers on Use of Oil Engines in Shovels, Locomotives, Dredges and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. For details, address F. X. La Fontaine, R. F. D. No. 5, Box 34, Joliet.

Urbana—April 21, 4:00 p.m. M. E. Lab. Lecture Room, Univ. of Ill. Subjects: Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J.; The Use of Internal Combustion Engines in Railway Work; Sources of Oil. Meeting of A.S.M.E. Student Branch of University of Illinois.

INDIANA

Anderson — April 27, 8:00 p.m., Woodman Hall, 806½ Main Street. Subject: Paper on The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo. Meeting of N.A.S.E. No. 16.

Indianapolis—April 20, Joint Meeting of A.S.M.E. Indianapolis Section and A.I.E.E. For details, address Homer Rupard, 113 Monument Circle, Indianapolis.

Kokomo—April 19, 7:30 p.m., Carpenters and Bricklayers Hall, 210½ N. Main Street. Subjects: Papers on The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp; The Daily Duties of a Diesel Engineer, by M. L. Black, New York. Meeting of N.A.S.E. No. 24.

IOWA

Des Moines — April 23, 8:00 p.m., I.O.O.F. Building, 2nd Floor. Subject: Paper on The Daily Duties of a Diesel Engineer, by M. L. Black, New York. Meeting of N.A.S.E. No. 2.

Keokuk—April 20, 8:00 p.m., 1010 Johnson Street. Subjects: Papers on Use of Oil Engines in Shovels, Locomotives, Dredges and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. Meeting of N.A.S.E. No. 15.

Ottumwa—April 20, 7:45 p.m., Carpenter's Hall, East Main Street. Subject: Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, American Brown Boveri Electric Corporation, Camden, N. J. Meeting of N.A.S.E. No. 10.

Tri-Cities—April 29. Subject: Gas in Industry, by Frank F. Canley, Mgr., Ind. Gas Dept., Peoples Gas Light and Coke Company, Chicago, Ill. Meeting of Tri-City Technical Council (and affiliation of A.S.M.E., A.S.S.T., A.C.S., Davenport Engineers, Quad City Foundrymen, and the Stationary Engineers). For details, address Harry Hoisington, Rock Island Arsenal, Rock Island, Ill.

KANSAS

Concordia—Meetings of N.A.S.E. No. 17 on April 20, 21 and 22. For details, address Joe Collins, 715 East 10th Street, Concordia.

Fort Leavenworth — April 23, 8:00 p.m., Knights of Columbus Hall, 411 Shawnee St. Subjects: Papers on The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York. Meeting of N.A.S.E. No. 11.

KENTUCKY

Henderson—Meeting of N.A.S.E. No. 8. For details, address Chas. D. Scott, 210 So. Alnis Street, Henderson.

MAINE

Orono—April 23, 4:15 p.m., Aubert Hall, Univ. of Maine. Subject: Consumption of Petroleum Products in Maine, by Leslie Hutchins; Specifications for Fuels Lubricant, by B. F. Brann; Recent Advances in Power Production, by C. A. Bartlett. Meeting of A.C.S. Main Section.

MASSACHUSETTS

Lowell—April 21, 2:00 p.m., Main Auditorium, Lowell Textile School. Subject: The film America's Industries will be shown by W. S. Price, Tide Water Oil Sales Corporation. Meeting of A.S.M.E. Student Branch of Lowell Textile School, with Student Branches of Tufts College, M.I.T. and Northeastern University invited; also other interested local organizations.

Worcester — April 23, 8:00 p.m., Worcester Polytechnic Institute. Subject: Aircraft Engine Development, by Arthur Nutt, Curtiss Aeroplane and Motor Company, Buffalo, N. Y. Meeting of A.S.M.E. Worcester Section, with locals invited.

MINNESOTA

Minneapolis — April 22, Dinner at 6:00 p.m., Central Y.M.C.A. Subject: Crank Case Dilution and Sludging of Automotive Engine Oil, by A. O. Ofstie. Meeting of A.S.M.E. Minneapolis Section, with locals invited.

MISSOURI

Columbia — March 31. Subject: Petroleum, by J. F. Norris, President, A.C.S.

May 11. Subject: Petroleum Cracking, by Dr. Roy Cross, Kansas City Testing Lab., Kansas City, Mo. Meetings of A.C.S. University of Missouri Section.

St. Louis—April 23, Dinner at 6:30 p.m., Meeting at 8:00 p.m., American Annex Hotel. Subject: The Oil-Electric Locomotive, by L. G. Coleman, Mgr., Locomotive Department, Ingersoll-Rand Company, New York, illustrated by lantern slides. Meeting of A.S.M.E. St. Louis Section, with locals invited.

NEBRASKA

Kearney—April 15, 7:30 p.m., Power Plant of Central Power Company. Subject: Lecture on Oil and Gas Engines, illustrated by slides, by Ed. C. Swan, Asst. Ch. Engr., Central Power Company. W. D. Sanders, President, N.A.S.E. No. 4, will read paper on Daily Duties of a Diesel Engineer by M. L. Black. Meeting of N.A.S.E. No. 4, with locals invited.

NEVADA

Reno—April 7. Subject: Paper on Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. Meeting of A.S.M.E. Student Branch of University of Nevada.

NEW JERSEY

Atlantic City—April 23, 8:00 p.m., Maharba Apartment Building, Penna. and Atlantic Avenues. Subjects: Papers on Use of Oil Engines in Shovels, Locomotives, Dredges and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. Meeting of N.A.S.E. No. 9.

Carneys Point, N. J.—April 20, 8:00 p.m., duPont Club. Subject: Anti-Knock Compounds for Automobile Engines, by W. S. Calcott. Meeting of A.C.S. South Jersey Section.

Jersey City—May 8, 8:00 p.m., Odd Fellows Hall, Bergen Square. Subjects: Papers on Use of Oil Engines in Shovels, Locomotives, Dredges, and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps,

by F. I. Kemp, Kansas City, Mo.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. Meeting of N.A.S.E. No. 1.

Long Branch—Meeting of N.A.S.E. No. 17. Subjects: Papers on Use of Oil Engines in Shovels, Locomotives, Dredges, and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. For details, address H. A. Pierce, 330 Columbus Place, Long Branch.

Newark — April 26, 8:30 p.m., 48 William Street. Subject: Diesel Engine Applied to Ice Making Plants, by John Skioch. Meeting of N.A.S.E. No. 3.

Passaic—April 24, 8:00 p.m., Smith Academy, Pennington Avenue near Prospect Street. Subject: Fitting the Oil Engine into Industrial Plants, by L. H. Morrison, Editorial Department, *Power*, New York. Julius Kuttner, Editor, *Oil Engine Power*, New York, will read paper entitled Left Alone with an Oil Engine, by Jack Holley. Meeting of N.A.S.E. No. 11, Passaic; No. 6, Hackensack; No. 2, Paterson.

Trenton—April 22, 8:00 p.m., Reception Room of Stacy-Trent Hotel. Meeting of Engineers Club of Trenton. For details, address J. B. Woolston, 41 So. Hermitage Ave., Trenton.

NEW YORK

Brooklyn — April 21, 8:10 p.m., Brooklyn Poly. Inst. Subject: The Daily Duties of a Diesel Engineer, by M. L. Black, New York; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo. Meeting of A.S.M.E. Student Branch of Brooklyn Polytechnic Institute.

Brooklyn — April 23, 8:30 p.m., Knights of Columbus Institute, 81 Hanson Place. Subject: The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Mgr., Kansas City Office, Worthington Pump and Machinery Corporation, Kansas City, Mo. Meeting of N.A.S.E. Nos. 41, 8 and 27.

Buffalo—April 20, 8:00 p.m., Hotel Statler. Subject: Modern Diesel Engine Practice, by J. T. Clancy, Sales Manager, Snow-Holly Works, Worthington Pump and Machinery Corporation. Meeting of A.S.M.E. Buffalo Section, with participating locals invited.

New York—April 22, 8:15 p.m., Engineering Auditorium, 29 West 39th Street. Subjects: The Whaley Engine, by W. B. Smith Whaley and Captain E. P. Jessop, U. S. N. retired; Some Recent Developments in Petroleum Technology, by Dr. Ben T. Brooks, Cons. Chemist, New York. Meeting of A.S.M.E. Metropolitan Section, with A.P.I., S.I.E., National Board of Fire Underwriters co-operating. All locals of other societies invited.

Schenectady — March 19. Subject: Power Transmission for Oil Engine Locomotives, by A. Lipetz, Cons. Engr., American Locomotive Company, Schenectady. Meeting of A.S.M.E. Eastern New York Section, Schenectady Branch, with A.C.S. invited.

Troy—Meeting of A.S.M.E. Student Branch of Rennsselaer Polytechnic Institute. For details, address James Platt, Rensselaer Poly. Inst., Troy.

NORTH CAROLINA

Raleigh—April 20, 7:00 p.m., Page Hall, North Carolina, State College. Subjects: Oil and Gas Power Cycles and Their Applications, by Prof. L. L. Vaughan, Head of M.E. Dept., N. C. State College; Oil and Gas Resources of the United States, by Prof. Wm. Jay Dana, Experimental Engrg., N. C. State College. Joint meeting of A.S.M.E. Carolinas Section-Raleigh Branch, and A.S.M.E. Student Branch of State College.

OHIO

Akron — April 24, 7:30 p.m., Red Room of Portage Hotel. Subject: Modern Diesel Engine Installations, by R. C. Demary. Special illustrated lecture on Diesel Engines. Meeting of N.A.S.E. No. 28, with all local organizations invited.

Cincinnati — March 25. Talk by Hubert C. Blackwell, V. P., Union Gas and Electric Company, on The Manufacture and Distribution of Gas, particularly as Affecting the City of Cincinnati. Meeting of A.S.M.E. Cincinnati Section.

Columbus — April 23, 8:00 p.m., Auditorium of Columbus Railway, Power and Light Company, 215 North Front Street. Subject: Diesel Oil Engines, by Harte Cooke, Engineer, McIntosh and Seymour Corporation, Auburn, N. Y.; Illustrated paper descriptive of Recent Developments in Combustion Engines in Europe, by Prof. C. A. Norman, M.E. Dept., Ohio State University. Meeting of A.S.M.E. Columbus Section, with locals of A.C.S., N.A.S.E. No. 38, and A.S.M.E. Student Branch of Ohio State University, invited.

Dayton—April 21, 7:30 p.m., 134 So. Jefferson Street. Subject: Stereoptican Slides on Oil and Gas Power. Lecture by Harry M. Swindler, M.E. Meeting of N.A.S.E. No. 37, with N.A.S.E. Nos. 27, Troy; 59, Piqua; 1, Middletown, invited.

Dayton—April 22, 6:15 p.m., Engineers Club of Dayton. Subject: Savings through Greater Utilization of Oil and Gas Power, by Earl H. Adams, Chief Engineer, Smith Gas Engine Company, Dayton. Open meeting of S.I.E. Dayton Chapter.

Portsmouth—April 24, 7:30 p.m., at N.A.S.E. Association's Hall, Corner Gallia and Gay Streets. Subjects: Papers on Use of Oil Engines in Shovels, Locomotives, Dredges, and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J. Meeting of N.A.S.E. No. 77.

Toledo — April 22, Meeting of A.S.M.E. Toledo Section, with locals invited. For details, address G. H. Bancroft, The Willys Overland Co., Toledo.

Youngstown — April 21, 8:00 p.m., Bushnell Hall, 127 West Federal Street. Lantern slide lecture on Gas and Oil Power, by O. P. Burr. Open meeting of N.A.S.E. No. 42.

OKLAHOMA

Tulsa — April 22. Subject: Diesel Engines, by Fred Thilenius, Asst. M.M., Prairie Pipe Line Company, Tulsa.

April 23, afternoon. Subject: Public Relations, by Earle W. Hodges, Empire Companies; Motor Fuels. (Speaker to be announced).

April 23, 8:00 p.m., Auditorium, Municipal Bldg. Subject: Hydraulic Principles of Fluid Flow in Pipe Lines—with Reference to the Transportation of Petroleum, by William G. Heltzel, Sinclair Pipe Line Company, Tulsa.

April 24, Sessions in morning, afternoon and evening. (Subjects and speakers to be announced.)

These are meetings of A.S.M.E. Mid-Continent Section and A.I.M. & M.E. Section, with locals invited. For details, address William G. Heltzel, c/o Sinclair Pipe Line Company, Tulsa.

OREGON

Corvallis — April 24, 2:00 to 5:00 p.m., Engineering Building, Oregon Agri. College. Subjects: Diesel Engines vs. Steam in the Logging Industry, by Student Branch members of Oregon Agri. College. Paper by member of A.S.M.E. Oregon Section.

April 24, 6 p.m., Banquet at Hotel Benton. Talk by Professor John R. DuPriest. Moving Pictures on the Petroleum Industry. Meeting of A.S.M.E. Oregon Section and A.S.M.E. Student Branch of Oregon Agri. College. Other locals invited.

PENNSYLVANIA

Bethlehem — April 29, 8:00 p.m., Physics Lecture Room, Lehigh University. Subject: Coal Processing, by W. H. Fulweiler, Chem. Engr., Union Gas Improvement Company, Philadelphia. Meeting of Lehigh Valley Engineers Club and A.C.S. Lehigh Valley Section.

Erie—April 20, 8:00 p.m., Chamber of Commerce Auditorium. Subject: Oil Electric Locomotives, by Hermann Lemp, Erie. Meeting of A.S.M.E. Erie Section, with locals invited.

Philadelphia—April 23, 8.15 p.m., at Franklin Institute, 15 So. 7th Street. Subject: By-Products of Coal. Speakers: W. H. Blauvelt, Cons. Engr., New York, on Power Possibilities from By-Products. Other speakers to be announced. Meeting of Franklin Institute with co-operation of Engineers Club, Local Sections of A.S.M.E., A.C.S. and other interested locals invited.

Pittsburgh—Joint meeting of Engineers Society of Western Pennsylvania and A.S.M.E. Pittsburgh Section. For details, address K. F. Treschon, William Penn Hotel, Pittsburgh.

Scranton—April 15, 8:00 p.m., 324 Adams Avenue. Subjects: Papers on Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Use of Oil Engines in Shovels, Locomotives, Dredges, and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo. Meeting of N.A.S.E. No. 16.

TENNESSEE

Knoxville—April 19, Luncheon Meeting at 12:15 p.m., University Cafeteria. Subject: Trend of Utility Gas Manufacture, by H. G. Bonner, Genl. Mgr., Knoxville Gas Company. Joint meeting of A.S.M.E. Knoxville Section, Knoxville Technical Society and N.A.S.E. No. 6.

TEXAS

El Paso — April 20, 8:00 p.m., El Paso Ice Co. Clubroom. Subject: Diesel Engines in the South-West, by E. Nevins, Ch. M.E., City of El Paso. Also papers on Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J.; The Daily Duties of a Diesel Engineer, by M. L. Black, New York; Use of Oil Engines in Shovels, Locomotives, Dredges, and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo. Meeting of N.A.S.E. No. 6, with all engineers of the city invited.

UTAH

Salt Lake City—April 24, 8:00 p.m., University Club. Subject: Oil Electric Motive Power, illustrated by lantern slides. Members of Engineering Staffs of General Electric Company and Ingersoll-Rand Company, will lead the discussion. Meeting of A.S.M.E. Utah Section with locals invited.

WASHINGTON

Hoquiam—April 14, 8:00 p.m., K. of P. Hall. Subjects: Papers on Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo. Meeting of N.A.S.E. No. 1.

WISCONSIN

Fond du Lac—April 15, 8:00 p.m., I.O.O.F. Hall. Subjects: Papers on Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J.; Use of Oil Engines in Shovels, Locomotives, Dredges and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo. Meeting of N.A.S.E. No. 5.

Madison—Meeting of N.A.S.E. No. 14. Subjects: Papers on Daily Duties of a Diesel Engineer, by M. L. Black, New York; Spare Parts as a Factor of Economy in Oil Engine Operation, by A. B. Newell, Camden, N. J.; Use of Oil Engines in Shovels, Locomotives, Dredges and other Mobile Equipment, by Hermann Lemp, Erie, Pa.; The Diesel Engine as a Drive for Compressors and Pumps, by F. I. Kemp, Kansas City, Mo. For details, address Paul G. Gauer, 939 University Ave., Madison.

News in the Field of Power

Brewster Upholds Present Maine Power Export Law

Believing a delay of at least two years will be wise, Governor Ralph O. Brewster declares for present continuation of the policy of forbidding the export of electrical power beyond the borders of the state, according to a dispatch in the *Christian Science Monitor*.

Stressing the point that "we are now in a period of economic and legal flux in the electrical world," he says:

It would seem to be the wise course to go slow and await further developments.

Once the barn door of exportation is open, it may be extremely difficult again to lock it. In 16 years under our established policy of prohibiting the exportation of hydro-electric power, there has been an increase from $2,000,000 to $20,000,000 in the assessed valuation of the public utilities distributing electricity.

Meanwhile there has been an increase of $70,000,000 in the valuation of their property for rate making purposes upon which the citizens of Maine are paying a rate calculated to give an earning power of 8 per cent.

This is a sturdy growth. The annual increase has been almost equal to the total valuation at the time this policy was adopted under the leadership of United States Senator Bert M. Fernald.

It has been urged that Maine's golden opportunity would be lost unless our policy was immediately changed and that our powers were becoming a less and less important factor in our national economic life.

The error of this conception would seem to be indicated by the recent entering into Maine from the Middle West of one of the most powerful electrical groups in the country and their acquisition of the largest single holding of developed and undeveloped Maine water powers at a very substantial price. These interests do not invest their money in economic graveyards and they came here with full knowledge of long established policy of the State of Maine.

Herbert Hoover is now earnestly warning against the menace of federal control of the electrical industry. No one at this time knows what limitations are constitutional or practicable by the state when electricity has begun to flow across state lines. The only sure guarantee at the present time of state control is to keep within state lines and out of interstate commerce.

We are told that if we permit a great power line to be established, carrying the hydro-electric energy out of the state, that we may legally provide for its recapture at any time there be a local demand. Certainly if it is unconstitutional, as claimed, to prevent its exportation in the first instance, it would be, at the proper time, contended that it was unconstitutional to attempt its recapture, especially as interests of large magnitude would then be introduced into the problem where they do not now exist.

Charter amendments might be used to establish a contact relationship in connection with these franchises, but the questions which have been raised regarding the propriety of these clauses would be urged with redoubled force if great investors of capital were desirous of their nullification.

It is also difficult to believe that any great development, costing, as is estimated, over $10,000,000 for transmission lines alone and carrying 3,000,000,000 kw.-hr. a year to industries in southern New England, which would to some extent necessarily be dependent upon these sources of supply, would ever be carried out if all this power was subject to recapture at any time the citizens of Maine might elect, and the great transmission lines themselves made useless, and this investment be thrown away or earnings thereof be paid by the citizens of Maine.

The water power available in New England is 4,000,830,000 kw.-hr. in an average year, and of this total it is estimated that 3,000,000,000 kw.-hr. would be generated in Maine, and could be delivered to industries at cost of approximately 1 cent per kilowatt hour.

It would clearly appear, however, that any transmission must depend upon a long-term contract to provide proper protection to the industries concerned.

We are in a revolutionary period in the electrical world. Two years ago we were told by proponents of export in Maine that our water powers were of negligible value and that Canadian power would soon be flowing into New England and then all chance of development of Maine's power would be lost.

The Canadian policy most concerned has now resolved any doubt as to their attitude by entirely prohibiting export of power for exactly the same considerations that have influenced the citizens of Maine.

Connecticut electrical companies have definitely and voluntarily adopted the policy of not crossing the state line in order to avoid any possibility of federal interference.

In this period of economic and legal flux in the electrical world it seems to me that it would be very unwise for Maine now to change the policy which it has upheld for 16 years.

My conclusions have been formed as a result of conversation on this subject during the last few months with Owen D. Young of the General Electric Co., Martin Insull of Chicago, Archibald R. Graustein, president of the International Paper Co., and Harry M. Verrill of Portland.

A.I.E.E. Regional Meeting Power Papers

The regional meeting of the A.I.E.E., which is to be held at Niagara Falls, May 26-28, will have papers of interest to *Power* readers as follows:

"Fire Protection for A.-C. Generators," by J. A. Johnson, Niagara Falls Power Co. and E. J. Burnham, General Electric Co.

"Automatic and Supervisory Control of Hydro-Electric Generating Stations," by F. V. Smith, Westinghouse Electric & Manufacturing Co.

"Tests on Niagara Falls Hydro-Electric Units," by J. A. Johnson, Niagara Falls Power Co.

"Speed Measurements of Rotating Machines," by P. A. Borden, F. K. Dalton and H. S. Baker, all of the Hydro-Electric Power Commission of Ontario.

N. Y. Water Power Authority Bill Defeated

The Democrats in the New York Assembly made their last fight for a water power authority on April 5 and were defeated. On a strict party vote they lost a resolution to take from committee the Hackenburg bill setting up a State Water Power Authority.

"For years the powerful water power interests have had a grip on the majority of this House, and with its aid have exploited the great water power resources of this state to the detriment of the people," Minority Leader Maurice Bloch said in urging the bill. "The Democratic party has consistently advocated that these resources belonged to all the people and should be owned, developed and regulated for, by and in their interest."

Carnegie Research Program Includes Coal Utilization

An extensive program has been arranged at the Carnegie Institute of Technology, Pittsburgh, Pa., in cooperation with the United States Bureau of Mines, for mining and metallurgical research for which eight research fellowships are available.

Most of the research work will be conducted in the laboratories of the Pittsburgh station of the U. S. Bureau of Mines adjacent to the campus.

One part of the program is of peculiar interest to the power plant field as it will cover the utilization of coal: The correlation of fusing temperature of coal ash with clinker formation in furnaces; study of reactivity of various cokes in air, carbon dioxide and steam; study of physical properties of coke in relation to domestic heating; drop of pressure in fluids flowing through aggregates; determination of the temperature solubility relationship between gasoline and methanol and the influence of mutual solvents; a study of the catalysts for the production of methanol from water, gas and hydrogen; effect of gaseous atmosphere on yields and composition of gas, tar and coke in the low-temperature carbonization of coal.

Kansas Municipal Water Plant Effects Fuel Saving

The City of Pittsburg, Kansas, operates its own water plant. The plant earned $42,748 net in 1925, according to a report made by W. J. Lapworth, plant superintendent.

The net earnings for 1924 were $40,530.49. Most of the saving effected in operation, according to Mr. Lapworth, was in the cutting down of the fuel bill. The 1925 fuel bill was $21,641.18 as compared with $24,550.41 the previous year.

The gross earnings for the two years were:

	1925	1924
Water charges	$86,426.89	$82,884.52
Steam heat	15,586.17	15,945.37
Tax levy	14,866.37	17,774.28
Miscellaneous revenue	19.70	149.38
Miscellaneous revenue	155.20	195.30
Penalties	754.60	731.92
Total	$117,808.93	$117,073.15
Less rebate	846.13	607.62
Plus house rent	594.00	607.50
Final total	$117,556.80	$117,680.65

Included in the figures for the net cost of operation are items of $60.75 for house upkeep and maintenance and $8,055 interest on outstanding bonds, in addition to the plant operation cost of $66,692.86. The total for the previous year was $74,808.65 and that of the year before $77,150.16.

The plant was purchased for $225,000 and is now valued at $634,001.21, it is stated.

New York State Hospital to Have New Power Plant

Under the provisions of a bill introduced in the Assembly by the Rules Committee the sum of $200,000 is appropriated out of the proceeds of state bonds for public improvements for constructing a power house at the state hospital for treatment of incipient pulmonary tuberculosis at Raybrook.

Muscle Shoals Power May Net $2,500,000 Yearly

No offer for Muscle Shoals which seeks to obscure the real amount of the subsidy demanded can hope to secure the approval of Congress. The law makers are fully aware that as a power proposition Muscle Shoals will turn into the Treasury of the United States $2,500,000 net profit annually. Some of those who have been urging fertilizer manufacture have tried to conceal the fact that their plans were supported by a large indirect subsidy to come out of electric power.

Production of Nitrogen Thought To Be Without Profit

Everyone wants to see a fixed-nitrogen industry built up in this country. Many members of Congress are perfectly willing to subsidize it, but they want to have the record clear as to just how much subsidy is to be paid. They want to know if the amount is fair and if it is calculated really to stimulate the fixation of nitrogen. Some think Muscle Shoals is just the place to centralize a nitrogen chemicals industry and would be willing to use public funds to attain that end, but they want the amount of the subsidy clearly understood.

Others are opposed to subsidies regardless of the merit of the undertaking. This includes some of those who favor high tariffs.

Still others of the members of the upper House feel that the $2,500,000 profit from power should be used in experimentation until some way is devised to produce nitrogen at a profit. At present no one of the prospective bidders, it is understood, is willing to guarantee any definite amount of nitrogen output, unless given a large margin to absorb losses. It is admitted that no one under existing conditions, can produce nitrogen at a profit at Muscle Shoals. It would seem that the secret cannot escape our chemists much longer. Germany not only is making synthetic nitrogen at a profit but is beginning to compete with the natural product in world markets. In view of that fact there is reluctance to enter into a long-time contract, carrying a substantial subsidy, when any day may bring forth developments which would make the subsidy unnecessary.

All bids for the government's Muscle Shoals properties were submitted on April 10.

Informal conferences with prospective bidders continued throughout the week of April 5. A group of executives representing public utility companies operating in Kentucky, Tennessee, Arkansas, Louisiana, Mississippi, Alabama, Florida, and Georgia, discussed their proposition to operate the nitrate plant and to distribute the surplus power.

W. B. Bell, President of the American Cyanamid Co., appeared before the committee on April 5.

It is understood that the committee is requiring bidders to submit propositions on the basis of an ultimate production of forty tons of nitrogen, with the understanding that the lease is to include the power properties and rights at Cove Creek. In addition the government is to build Dam No. 3.

Electricity Supply Bill Discussed in England

The text of the Electricity Supply Bill of 1926, which has been under discussion in England recently, and the report of the committee appointed to review the national problem of the supply of electrical energy, has been published, according to *The Engineer*.

The government's proposals, as outlined in a speech by Mr. Baldwin, at Birmingham recently, are now set forth in more or less definite terms.

At the present rate of increase, viz., 19 per cent per annum, the consumption of electricity would rise from the existing value of about 200 units per head of population to 500 units by 1940, or thereabouts. It is estimated that under the new scheme, current would be supplied at an average price of 2 cents per unit, whereas under existing conditions it would not be reduced below 3 cents or 3½ cents per unit. The adoption of the scheme, it is claimed, would result in the former case in an annual saving of $222,500,000 on the national electricity supply bill when the consumption reaches 500 units per head, and $334,000,000 in the latter case.

Public Utility Plant Output Makes New Record

The daily production of electricity by public-utility power plants in February surpassed all previous records with an average rate for the month of 199,700,000 kw.-hr., practically 200,000,000 kw.-hr. per day. The average daily production of electricity by the use of water power also exceeded all previous daily rates, with an average for the month of 67,600,000 kilowatt-hours.

The total output for January and February of this year was about 11 per cent larger than for the same months in 1925 and the output in 1925 was only 5½ per cent larger than the output for the same months in 1924.

The following table shows the average production of electricity and the proportion produced by water power for the three months included in this report and the same months of the previous year:

	Kw.-hr.	Produced by Water Power Per Cent
1924		
December	178,600,000	32
1925		
January	179,700,000	30
February	178,600,000	35
December	198,500,000	32
1926		
January	197,300,000	32
February	199,700,000	34

Committee Approves Standards Bureau Power Plant

A central power plant for the Bureau of Standards, to cost $200,000, has been approved by the Committee on Public Buildings and Grounds. The plant was installed to heat only two buildings—all that the Bureau had at the time. The number now has increased to twenty-two, with the result that boilers have had to be installed in some of the newer buildings.

Ericsson Memorial To Be Dedicated May 29

The monument to Ericsson, which has been under way for several years, will be dedicated on May 29 at Washington, D. C. This beautiful memorial to the ingenious Swedish engineer was made by the well-known sculptor, James Fraser of New York City. The Society of Swedish Engineers expect to award a medal to some outstanding engineer of Swedish ancestry on the same occasion.

Public Should Know Coal Industry's Intentions

To learn what the industry itself is doing to insure the public a continuous supply of coal is one of the principal objectives of Representative James S. Parker, of New York, in the investigation which he is directing in Congress. Mr. Parker is chairman of the Interstate and Foreign Commerce Committee of the House of Representatives.

Mr. Parker believes the country wants to know, and is entitled to know, exactly what the industry proposes to do toward guaranteeing a steady supply of this necessity of life. He points out that other businesses manage to settle their troubles without plunging whole sections of the country into famine.

Steam Users' 1925 Boiler Explosion Report

In the 1925 Annual Report of the Committee of Management of the Manchester Steam Users' Association, an organization for the prevention of steam boiler explosions and for the attainment of economy in the application of steam, Manchester, England, the statement is made that, the total number of examinations made were 24,313. Of these, 11,315 were "entire" and "internal," with the boilers at rest and prepared.

"Since the publication of its last report the association had recorded the occurrence, outside its ranks, of 54 boiler explosions in the United Kingdom. These resulted in the killing of eight persons and injury to thirty-six others. Twenty-three of these explosions, by which four persons were killed and seventeen others injured, may be termed boiler explosions proper, while the remaining thirty-one, killing four persons and injuring nineteen others, may be termed miscellaneous explosions, that is those arising from steam pipes, stop valves, kiers, drying cylinders, bakers' ovens, etc."

American Welding Society Program

The annual meeting of the American Welding Society, which will be held in New York City, April 21 to 23, will have papers of interest to the power plant field on its program. These technical papers are planned to form a symposium on the subject of design of welded joints in several industries:

Wednesday—Gas Welding Committee meeting, S. W. Miller, chairman; Electric Arc Welding Committee, H. M. Hobart, chairman.

Thursday — Business session of society; "Design of Joints in Piping Installations," by L. J. Sforzini; "Design of Welded Joints with Special Reference to Pressure Vessels," S. W. Miller, consulting engineer, Union Carbide and Carbon Research Laboratories; "The Design of an Arc-Welded Pressure Vessel," by L. H. Burkhart, chief engineer, Struthers-Wells Co.; "Design of Welded Joints for Tanks and Containers," A. C. Vick, engineering department, Detroit Range, Boiler & Steel Barrel Co.; dinner dance in evening.

Friday—Meeting of the American Bureau of Welding; inspection trip to the Metal and Thermit Corporation; meeting of board of directors of the American Welding Society.

Activity in Hydraulic Turbine Installation Indicated

Recent activity in water-power development, indicated by news items from various parts of the world, receives confirmation through the following:

Hydraulic machinery contracts for 17 units totaling nearly half a million horsepower have lately been secured by the William Cramp & Sons Ship and Engine Building Co., its subsidiaries and licensees. The turbines, water wheels and other hydro-electric devices comprising these orders will be installed in Brazil, Japan, Canada and the United States. One contract calls for a 56,000-hp. impulse wheel, the highest powered of its kind in the world.

All of the machinery for installation in foreign countries, with the exception of seven units contracted for in Canada, will be built by the I. P. Morris Department of the Cramp Co. in Philadelphia. These contracts are as follows: Two 5,000-hp. Moody propeller turbines for the Maribondo development in Brazil and two 29,000-hp. turbines for the Nippon Electric Co. of Japan.

The Dominion Engineering Works, Ltd., of Montreal. Canadian licensee of the Cramp Co., has secured contracts for seven hydro-electric units as follows: Three 30,000-hp. units and three 21,000 hp. units for the Canadian International Co., and one 28,000-horsepower Moody propeller unit for the Manitoba Power Company.

For domestic installation, the Philadelphia plant has also been awarded the contract for two 31,000-horsepower and one 25,000-horsepower units for the Norwood Development of the Carolina Power & Light Company.

The 56,000-horsepower impulse wheel, unrivaled in size and power in the world, will be built for the Southern California Edison Company in the San Francisco plant of the Pelton Water Wheel Company, which is owned by the Cramp Company. Other new contracts booked by the Pelton plant include two 30,000-horsepower impulse wheels for the Feather River Power Company.

German Iron Magnate Dies at 84 Years of Age

August Thyssen, the pioneer industrialist in the German iron and steel industry, died on April 4 at his Lindsberg castle, near Muehlheim. He was 84 years old. His death, due to pneumonia, followed a complicated operation on his eye a few weeks ago.

He was a contemporary of the fathers of Bertha Krupp von Bohlen and Hugo Stinnes and other pioneers of the Rhenish-Westphalia iron industry. Unlike most of his competitors he was a self-made man.

New Report Shows Increases in Canadian Water Power

A report on the Water Power Resources of Canada, bringing previously published figures up-to-date, has just been issued by the Water Power Branch of the federal Department of the Interior. The report states that the known available water power in Canada, from all sources, is 18,255,000 hp. for conditions of ordinary minimum flow and 32,076,000 hp. ordinarily available for six months of the year.

It is believed that these are conservative estimates, since an analysis of water power plants scattered from coast to coast concerning which complete data are available as to turbine installation and satisfactory information as to stream flow, gives an average machine installation 50 per cent greater than the ordinary six-month flow power. "Applying this," says the report, "the figures quoted above, therefore, indicate that the present recorded water power resources of the Dominion will permit of a turbine installation of 41,700,000 horsepower.

"The total installation to date in waterwheels and turbines throughout the Dominion is 4,290,428 hp. In other words, the present turbine installation represents only 10¼ per cent of the recorded water power resources."

Dealing with water power used by the pulp and paper industry of the Dominion, the report says: "A recent development that is doing much to enhance the importance of the Canadian pulp and paper industry is the growing movement of American mills towards Canada.

"There are 116 pulp and paper mills in Canada operating water power developments to furnish their own motive power. These mills have a combined installation of 481,971 hp. A number of these mills purchase additional power from central-station organizations while still other mills purchase all their power. Up-to-date figures of this purchased power are not at present available but a conservative estimate places the amount at about 275,000 hp., so that the industry draws power from a hydraulic installation of about three-quarters of a million hp."

Generating Equipment Exports Decline in January

According to the Electrical Division of the Department of Commerce, there was a decline in the shipments of generating equipment and transformers during January, 1926. The heaviest decrease being shown in the case of large alternating-current generators, shipments of which during January were valued at only $73,087 as compared with $250,953 for January of last year. Exports of switchboard equipment during the month totaled $511,407 as compared with $143,079 for the same month of 1925. Exports of power switches were maintained at approximately the same value as during January a year ago, though the number of units was doubled. There was a decline in the value of lightning arresters and other protective devices as well as in watt-hour meters, but this was very nearly balanced by gains made in shipments of volt meters, ammeters and other similar instruments.

Society Affairs

The Detroit-Ann Arbor Section of the A.I.E.E. will hold a meeting on April 23. E. L. Bailey will discuss "Motors, Power Factor and Power Factor Rates."

The St. Louis Section of the A.I.E.E. will hear C. A. Butcher, Westinghouse Electric & Manufacturing Co., speak on "Automatic Stations," at its April 21 meeting.

The National Museum of Engineering and Industry will hold its annual meeting at 29 West 39th St., New York City, on April 29, for the election of trustees and transaction of other business.

The Colorado Section of the A.S.M.E. will hear G. W. Gavin, U. S. Bureau of Mines, speak at the April 23 meeting at the Metropole Hotel, Denver, on "Present Shale Development of Government Plant at Rifle."

The Indianapolis Section of the A.S.M.E. will hold a joint meeting with the A.I.E.E. on April 20. George A. Orrok, consulting engineer of New York City, will speak on "Steam Generators and Radiant Heat."

The Oregon Section of the A.S.M.E. will hold its all-day April 24 "Oil and Gas Power" meeting at Corvallis, Ore. "Diesel Engines vs. Steam in the Logging Industry" will be discussed in the afternoon by the Student Branch members. After the banquet at the Hotel Benton, Prof. Du Priest will present a film, "The Petroleum Industry."

The Iron & Steel Electrical Engineers annual convention, which is to be held at the Hotel Sherman, Chicago, Ill., June 7-10, will have papers of interest to *Power* readers as follows: "A. I. & S. E. E. Recommendations on Rules for the Safe Operation of Electric Overhead Traveling Cranes;" "Additions to Rolling Mills at Steubenville Plant of the Wheeling Steel Corp.," by M. J. Conway; "Refractories for the Iron and Steel Industry," by M. S. Booze; "Boilers," by M. J. Conway.

The Mid-Continental Section of the A.S.M.E. will have as the attraction for the April 23 joint meeting with the A.I.M.E., which will be held in the auditorium of the Municipal Building, "Hydraulic Principles of Fluid Flow in Pipe Lines," by G. Heltzel of the Sinclair Pipe Line Co.

Business Notes

The Patterson-Kelley Co., 100 Park Ave., New York City, announces the purchase of the business, patents, etc., of the Otis Heater from the King Construction Co. of North Tonawanda.

The Reading Iron Co., Baer Bldg., Reading, Pa., announces the appointment of E. P. Hannig as the representative of the company for Buffalo, and vicinity, with offices at 916 Prudential Bldg., Buffalo, N. Y.

The Morse Chain Co., Ithaca, N. Y., has recently appointed Maurice R. Hart, who has been for several years on the sales department, as manager of its Buffalo district office, which is in the Ellicott Sq. Building, Buffalo, N. Y.

The McClave-Brooks Co., Scranton, Pa., announces that Everett H. Alison, formerly assistant sales manager of the Chicago district, has been appointed district sales manager in the Cleveland office, which is now located at 453 Leader Bldg. Mr. Alison succeeds Granville B. Lane, who is no longer connected with the company.

The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., announces a reorganization of its sales system, which has been in course of development for some time. The men and their new positions are: E. H. Sniffen becomes vice-president; T. J. Pace becomes manager, supply department; G. H. Froebel, manager of the marine department; J. M. Curlin, industrial sales manager; M. B. Lambert, transportation sales manager; A. C. Stremer, assistant director of sales; H. W. Smith, generating apparatus manager; A. J. Manson, traction manager; O. F. Stroman, motor apparatus manager; R. A. Neal, switchgear apparatus manager; G. A. Sawin, distribution apparatus manager; Louis Hausmann, formerly in the general engineering department of the South Philadelphia works, has been appointed a power engineer in the Chicago district office.

Trade Catalogs

Engines — Wilson-Snyder Manufacturing Co., Pittsburgh, Pa. "Pipe Line Pumping Engines," is the name of Bulletin W-141-A, which contains descriptions and pictures of typical installations in mountainous country.

Belts, Leather—J. E. Rhoads & Sons, 35 North Sixth St., Philadelphia, Pa. The "Belt Users' Book" which contains rules, suggestions and information on the use of belting has recently been published by this firm. Charts for arc of contact and belt speed, as well as tables on ratings and dimensions are given.

Water-Cooled Furnace Walls—Power Specialty Co., 111 Broadway, New York City. "Foster Water Backs" is the title of Bulletin 261 recently published by the company to describe this new equipment. Pictures of the wall as installed as well as detailed drawings are included.

Power Factor—The General Electric Co., Schenectady, N. Y. Catalog GEA-232, "Power Factor and Means for Its Improvement," is a well illustrated publication which presents in a simple and systematic manner authoritative information on means for power factor improvement in industrial plants. It is a practical treatise on power factor with the mathematics reduced to simple arithmetic.

Coming Conventions

American Boiler Manufacturers Association. D. W. Glanzer, 840 Rockefeller Bldg., Cleveland, Ohio. Annual convention at Homestead, Hot Springs, Va., June 1-2.

American Institute of Electrical Engineers. F. L. Hutchinson, 29 West 39th St., New York City. Regional meetings: Madison, Wis., May 6-7, and at Niagara Falls, May 26-28. Annual convention at White Sulphur Springs, W. Va., June 21-25.

American Refractories Institute, D. A. Texter, 2202 Oliver Bldg., Pittsburgh, Pa. Annual meeting at Bellevue-Stratford Hotel, Philadelphia, Pa. May 12.

American Society for Testing Materials. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Convention at Haddon Hall, Atlantic City, N. J., June 21-25.

American Society of Mechanical Engineers. Calvin W. Rice, 29 West 39th St., New York City. Regional meeting at Providence, R. I., May 3-6. Spring convention at San Francisco, Calif., June 28-30.

American Water Works Association. W. M. Niesley, Assistant to Sec., 170 Broadway, New York City. Annual convention at Hotel Statler, Buffalo, N. Y., June 7-12.

American Welding Society. M. M. Kelly, 29 West 39th St., New York City. Annual convention at 29 West 39th St., New York City, April 21-23.

Association of Iron & Steel Electrical Engineers. John F. Kelly, 1007 Empire Bldg., Pittsburgh, Pa. Exposition and convention at Hotel Sherman, Chicago, Ill., June 7-10.

International Electrotechnical Commission. F. V. Magalhees, 708 Fifth Ave., New York City. Meeting at 29 West 39th St., New York City, April 13-22.

Master Boiler Makers Association. Harry D. Vought, 26 Cortlandt St., New York City. Annual convention at the Statler Hotel, Buffalo, N. Y., May 25-26.

National Association of Stationary Engineers. F. W. Raven, 417 South Dearborn St., Chicago, Ill. Convention at Atlantic City, begins Sept. 14. Erroneously announced as Sept. 6-11. Annual conventions and exhibitions of state association are scheduled as follows: **Indiana State Association,** F. L. Clifford, 653 South Union St., Kokomo, Ind., Convention at Lafayette, Ind., May 10-15; **Kansas State Association.** H. S. Dukes, School for the Blind, Kansas City, Mo. Convention at Abilene, Kans., May 19-21; **Illinois State Association.** W. L. Hamilton, 719 Ninth St., Decatur, Ill. Convention at Decatur, Ill., June 2-4; **New England States Association.** Freeman L. Tyler, 32 Briggs St., Taunton, Mass. Convention at New Bedford, Mass., June 16-19; **Ohio State Association.** T. S. Garrett, 2622 E. Second St., Dayton, Ohio, Convention at Newark, Ohio, June 17-19; **Connecticut State Association,** George F. Klopfer, 30 East Pearl St., New Haven, Conn., Convention at Norwich, Conn., June 25-26; **Wisconsin State Association,** R. L. Scott, Eau Claire, Wis. Convention at Milwaukee, Aug. 3-6; **Minnesota State Association,** C. A. Nelson, 800 22nd Ave., N. E. Minneapolis, Minn. Convention at Rochester, Minn., Aug. 4-6; **New Jersey State Association,** S. G. Dalrymple, 111 Hutton St., Jersey City, Convention at Atlantic City, Sept. 12; **Pennsylvania State Association,** Frank J. McCarron, 3647 North 11th St., Philadelphia, Convention at Philadelphia, Sept. 12-13.

National Board of Boiler and Pressure Vessel Inspectors. C. O. Myers, 14 Commercial National Bank Bldg., Columbus, Ohio. National Board meeting at Chicago, Ill., May 17-18.

National District Heating Association. D. L. Gaskill, Greenville, Ohio. Convention at Niagara Hotel, Niagara Falls, June 1-4.

National Electric Light Association. A. Jackson Marshall, 29 West 39th St., New York City. Forty-ninth convention and manufacturers' exhibition, Atlantic City, May 17-21.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	April 5 1926
Pool 1	New York	$2.60@$2.85
Smokeless	Boston	1.48
Clearfield	Boston	1.75@ 2.00
Somerset	Boston	1.85@ 2.15
Kanawha	Columbus	1.40@ 1.70
Hocking	Columbus	1.40@ 1.70
Pittsburgh	Pittsburgh	1.90@ 2.00
Pittsburgh gas slack	Pittsburgh	1.50@ 1.60
Franklin, Ill.	Chicago	2.35@ 2.50
Central, Ill.	Chicago	2.00@ 2.10
Ind. 4th Vein	Chicago	2.10@ 2.25
West Ky.	Louisville	1.15@ 1.50
S. E. Ky.	Louisville	1.50@ 1.60
Big Seam	Birmingham	1.75@ 2.25
Anthracite Gross Tons		
Buckwheat No. 1.	New York	2.10@ 3.50
Buckwheat No. 1.	Philadelphia	2.50@ 3.00
Birdseye	New York	1.60@ 2.00

FUEL OIL

New York—Apr. 8, light oil, tank-car lots; 28@34 deg. Baumé, 5½c. per gal.; 36@40 deg., 6c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Mar. 30, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.07½ per bbl.; 26@28 deg., $2.12½ per bbl.; 28@30 deg., $2.17½ per bbl.; 30@32 deg., $2.22½ per bbl.; 32@36 deg., gas oil, 6c. per gal.; 38@40 deg., 6.5c. per gal.

Pittsburgh—Mar. 30, f.o.b. local refinery; 30@34 deg., fuel oil, 6c. per gal.; 36@40 deg., fuel oil 6½c. per gal.

Dallas—Apr. 3, f.o.b. local refinery 26@30 deg., $1.65 per bbl.

Philadelphia—Apr. 2, 27@30 deg., $2.31@$2.37 per bbl.; 18@22 deg., $1.93@$1.99; 13@19 deg., $1.74@$1.80 per bbl.

Cincinnati—Apr. 6, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Apr. 6, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.35@$1.45 per bbl.; 26@30 deg., $1.45@$1.55; 30@32 deg., $1.65@$1.70.

Boston—Apr. 6, tank-car lots, f.o.b.; 12@14 deg. Baumé, 6c. per gal.; 28@32 deg., 4.65c. per gal.

New Plant Construction

Ark., Little Rock—Arkansas Water Co., S. R. Brough, Supt., 112 East 7th St., plans improvements to waterworks including the installation of a 1,500,000 g.p.m. pump, etc. Work will be done by owner's forces.

Calif., Anaheim—City, E. B. Merritt, Clk., plans to purchase one 1,200 to 1,600 g.p.m. deep well pump, one vertical, 440 v. 3 ph., 50 cycle, 960 r.p.m. motor.

Calif., Los Angeles—Bd. of Supervisors, Los Angeles County, Los Angeles, will receive bids until April 19 for a centrifugal pump for well.

Calif., North Sacramento—City trustees is receiving new bids for the construction of a sewage pumping plant, sanitary outfall sewer, trunk line, etc.

Calif., San Francisco—E. H. Rollins & Sons & S. Waldo Coleman, 315 Montgomery St., awarded contract for the construction of a 30 story office building on Montgomery St. to Dinwiddie Construction Co., Crocker Bldg. $6,500,000.

Calif., Santa Barbara—Biltmore Hotel, c/o B. G. McDougall, 535 Sacramento St., San Francisco, Archt., is having plans prepared for the construction of a hotel at Leadbetter Point. Estimated cost $4,000,000. W. G. Clark, 318 West 9th St., Los Angeles, is engineer.

Conn., Stamford—S. Zatkin, Woolsey Road, awarded contract for the construction of a 4 story apartment on Highland St. to Stamford Construction Co., Strand Bldg. Estimated cost $600,000.

D. C., Washington — U. S. Engineers Office, War Dept., will receive bids until May 4 for the construction of a power plant for water supply project.

Fla., Coral Gables—Coral Gables Rest Resort Corp., will soon receive bids for the construction of a hotel including steam heating system, swimming pool, etc. Estimated cost $10,000,000. J. E. O. Pridmore, 38 South Dearborn St., Chicago, Ill., is architect.

Fla., Fort Lauderdale — Florida Hotel Association, I. C. Overdorff, Pres., awarded contract for the construction of a 3 story hotel on Mandaley Blvd. to Lake Mabel Development Corp. Estimated cost $500,000.

Ill., Chicago—Building Construction Employers' Association, E. M. Craig, Secy. and Bus. Mgr., Chamber of Commerce Bldg., is having preliminary plans prepared for the construction of a 21 story office building at La Salle St. and Wacker Drive. Estimated cost $4,000,000. Architect not selected.

Ill., Chicago—Syndicate, c/o D. W. F. Turbyfill, 40 North Dearborn St., Archt., is having plans prepared for the construction of an 11 story apartment at Fargo Ave. and Sheridan Road. Estimated cost $700,000.

Ill., Chicago—W. L. Wallen, Jr., 6712 North Clark St., will soon receive bids for the construction of an 8 story apartment and stores building at 5200 Sheridan Road. Estimated cost $2,500,000. Roy F. France & Co., 155 North Clark St., are architects.

Ill., Evanston — National Biscuit Co., West 15th St., New York, N. Y., awarded contract for the construction of a power plant and machine shop, at Keeney and Custer Aves., here, to R. C. Wieboldt Co., 1534 West Van Buren St., Chicago. Estimated cost $300,000.

Ill., Springfield — City, W. J. Spaulding, City Hall, Comr., plans extensions and improvements to electric distribution system and light and power plant during 1926. Estimated cost $50,000.

Ia., Des Moines—Wood Bros. Thresher Co., East 20th and Washington Sts., awarded contract for the construction of a manufacturing and power plant to Truscon Steel Co., 411 Hubbell Bldg. Estimated cost $250,000.

Ia., Iowa City—State Board of Education, W. H. Gemmill, Secy., State House, Des Moines, awarded contract for the construction of a power and heating plant for State University here to A. Alexander, 503 Frankel Bldg., Des Moines. $238,000.

Kan., Eldorado—City defeated $450,000 bonds at election Mar. 16 for improvements to waterworks including pumps, etc., also a dam across Willow Creek, Black & Veatch, 700 Mutual Bldg., Kansas City, are engineers.

Kan., Oswatomie—City plans an election soon to vote $55,000 bonds for improvements to water works and light plant. Burns & McDonnell, 401 Interstate Bldg., Kansas City, are engineers.

Ky., Washington—The Kentucky Hydro Electric Co., subsidiary of the Kentucky Utilities Co., M. E. Taylor Bldg., Louisville, has made application to the Federal Power commission for permit to construct a 134,000 hp. hydro electric power plant including spillway, power house and dam, approximately 1000 ft. long and 200 ft. high on the Cumberland River.

La., Franklin—City plans improvements to water and light plant. Estimated cost $175,000. H. A. Mentz, Hammond, is consulting engineer.

Mass., Cambridge (Boston P. O.)—Holy Ghost Hospital, is receiving bids for the construction of a 5 story, 45 x 155 ft. addition to hospital. Estimated cost $500,000. W. H. McGinty, 241 Adams St., Dorchester, is architect.

Mass., Somerville (Boston P. O.)—Wellington Coal Co., E. H. Wellington, Pres., 211 Bridge St., East Cambridge, plans the construction of a coal handling plant on Somerville Ave., here. Estimated cost $40,000. Private plans.

Miss., Biloxi—Commission Council, plans the construction of an electric light plant.

Miss., Gulfport—Mayor and Bd. of Commissioners, will receive bids until April 15 for furnishing and installing two direct connected motor driven centrifugal pumps, 1,000 and 1,500 g.p.m..

Miss., Lula—Bd. of Water Commissioners, N. Yeates, Secy., will receive bids until May 1 for the construction of a waterworks system including one centrifugal pump with 5 hp. motor, one 7½ hp. gas or oil engine for drive belt, and 50,000 gal. tank on 100 ft. tower, etc.

Mo., Poplar Bluff—City will soon receive bids for a 400 hp. boiler, conveyor, etc. for power plant.

Mo., St. Louis—S. Hamburg, Jr., et al, Arcade Bldg., is having preliminary plans prepared for the construction of a 6 story apartment on Union Blvd. Estimated cost $500,000. Private plans.

N. J., Trenton—City Commission, plans the installation of a 3,000,000 g.p.m. centrifugal pump with two gas auxiliary engines in Pennington Avenue water station. Estimated cost $5,000. A. Bugbee, City Hall, is engineer.

N. Y., Buffalo—Jewish Hotel Association of Buffalo, 1067 Broadway, plans the construction of a hospital on Niagara Falls Blvd. Estimated cost $650,000.

N. Y., New York—Consolidated Gas Co., 130 East 15th St., awarded contract for the construction of an 18 story office building at Irving Place and 14th St. to Ken-Well Contracting Co., 45 East 17th St. Estimated cost $1,500,000.

N. Y., New York—Jatison Construction Co., Inc., c/o Schwartz & Gross, 347 5th Ave., Archts., will build an 18 story office building at 48 West 37th St., by day labor. Estimated cost $1,000,000.

N. Y., New York — Lower Broadway Properties, c/o H. C. Severance, 36 West 44th St., Archt., will soon receive bids for the construction of a 35 story office building at Broadway and New St. Estimated cost $2,500,000. D. M. Oltarsh, 36 West 44th St., is engineer.

N. Y., New York—Presbyterian Hospital, 17 East 42nd St., awarded contract for the construction of a nurses' home at 165th St. and Ft. Washington Ave., to M. Eidlitz, 41 East 42nd St. Estimated cost $1,500,000.

N. Y., New York—Tenth Holding Corp., c/o R. T. Lyons, 342 Madison Ave., Archt., is having plans prepared for the construction of a 21 story hotel at Madison Ave. and 49th St.

N. C., Lexington—Tallassee Power Co., Badin, plans the construction of a 20 ft. dam on the Yadkin River, about 20 miles south of here.

N. C., Raleigh—State Hotel Co. plans the construction of an 8 story hotel on Dawson St. Estimated cost $500,000. W. Smith, Citizens Bank Bldg., is interested.

N. D., Harvey—City will receive bids until April 19 for the construction of a waterworks system including power house, two centrifugal pumps, etc. Estimated cost $20,000. T. R. Atkinson, Bismarck, is engineer.

O., Cincinnati—Commissioners Hamilton County, will receive bids until April 20 for the construction of sanitary sewers, Dist. 1, sewer 16 and Dist. 3, sewer 11 including pumping stations and equipment complete at Beechwood and Edgemont subdivisions. Estimated cost $31,644 and $108,204 respectively. L. C. Boyatt, Court House, is engineer.

O., Cleveland — The Cleveland Electric Illuminating Co., Illuminating Bldg., awarded contract for the construction of 2 electric control stations at Front St. and Pleasant Valley to D. Gelchrist, Berea, also 2 electric control stations at Hillside and Center Ridge Roads to R. S. Ursprung, Perry-Payne Bldg., Cleveland. Total estimated cost $100,000.

Okla., Bartlesville — Phillips Petroleum Co., awarded contract for the construction of a 7 story office building to W. S. Bellows, 812 Herskowitz St. Estimated cost $500,000.

Tennessee—Southern Cities Power Co., Chattanooga, plans the construction of electric power plants at Waynesboro, Savannah, Clifton and Collinwood.

Tex., Cleburne—Gulf Colorado & Santa Fe Ry. Co., 408 Union Depot Bldg., Galveston, awarded contract for the construction of a group of shop buildings including boiler house, etc., here, to Anderson Bros., El Paso. Estimated cost $505,000. F. Merritt, 408 Union Depot Bldg., Galveston, is chief engineer.

Tex., San Antonio—H. C. Thorman & Associates, 125 East Travis St., plans the construction of one hotel and two hotel and apartment buildings, all 12 story, at Devine and Robinson Roads. Estimated total cost $2,000,000. J. N. McCammon, Dallas, is architect and engineer.

Tex., Sinton—Texas Central Power Co., Frost Bldg., San Antonio, will receive bids about April 30 for the construction of a 30 ton ice plant. Estimated cost $60,000. Private plans.

Wash., Seattle — F. K. Struve, Stuart Bldg., plans the construction of an office and stores building at 6th and Olive Sts. Estimated cost $1,000,000.

Wis., Gays Mills—Interstate Power Co., c/o A. Ortin, Mgr., Dubuque, Ia., is receiving bids for the construction of a hydro-electric power plant, 2 units on Kickapoa River, here. Estimated cost $60,000. Private plans.

Wis., La Crosse—Syndicate, c/o A. F. John, 120 Wisconsin St., Milwaukee, is having preliminary plans prepared for the construction of an 8 story hotel, here. Estimated cost $500,000. M. Tullgren & Sons, 9 Waverly Place, Milwaukee, are architects.

Wis., Milwaukee—I. Miller, 114 Grand Ave., is having plans prepared for the construction of an 8 story apartment at 13th and Wells St. Estimated cost $500,000. J. Leiser, 105 Wells St., is architect.

Ont., Listowel—Town Council, R. B. Hanna, Supt., plans to replace steam standby system with gasoline plant in pumping station. Estimated cost $10,000.

Ont., London—London Life Insurance Co., E. E. Reid, Mgr., awarded contract for the construction of a 4 story office building on Wellington St., to Yates Construction Co., 17 Main St., East Hamilton. Estimated cost $1,000,000.

Que., St. John—The Leaside Engineering Co., Ltd., Leaside St., Toronto, plans the construction of a pulp and paper mill, 200 ton daily capacity, two hydro-electric power developments, here; also 25 mi. railway extension in Lake St. John Dist.

Que., Sherbrook—L. N. Audet, 30 Wellington St., Archt., will receive bids until April 15 for the construction of a 4 story convent including ventilation and forced water heating system by oil, for Sisters St. Famille. Estimated cost $600,000.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are prices to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

CURRENT prices of power-plant and electrical supplies show little change from the Mar. 9 level at principal centers. Highest grade babbitt metal is up about ⅛c. while No. 4 dropped ½c. per lb. during month. Wire solder advanced 2c. per lb. in 100 lb. lots and less. Declines, however, developed in cotton waste, linseed oil, small sized attachment plugs and armored cable.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

Fire Protection — 50-Ft. Lengths

Underwriters' 2½-in., coupled, sing'e jacket ..... (net) 74c. per ft.
Common, 2½-in., cotton-rubber lined ..... 80c. per ft. list less 40%

Air—Best grade

¾-in., per ft. ..... 3-ply .... $0.37½ 4 ply .. $0.46

Steam—Discounts from List

First grade ..... 30-10% Second grade ..... 40% Third grade .. 40-10%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade ..... 50% Second grade 50-10%

LEATHER BELTING—List price, 24c. per lin.ft. per inch of width for single ply at New York warehouses.

Grade	Discount from list
Medium	40-5%
Heavy	30-10%

RAWHIDE LACING { For cut, best grade, 50%, 2nd grade, 6?%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 50%; sides, 41c. per sq.ft.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$1.05
Asbestos for high-pressure steam, ⅛ in.	1.85
Duck and rubber for piston packing	1.05
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.95
Wire insertion asbestos sheet	1.40
Rubber sheet	60
Rubber sheet, wire insertion	85
Rubber sheet, duck insertion	65
Rubber sheet, cloth insertion	30
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
For low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York $2.50 per bbl. without bags, in carload lots delivered on job. Bag charge of 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, 3 to 15-in. beams and channels and 3 to 6-in. angles, tees, and plates, all $3.34 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	13.00@17.50	19.00	20.00
Colored	10.00@14.00	10.00	17.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.16
New York	.18
Cleveland (*per thousand*)	36.00

LINSEED OIL—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.83½	$0.96	$0.85

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Current	1 Yr. Ago	Current	1 Yr. Ago
Red	$15.25	$16.25	$16.75	$17.75
White	15.25	16.25	15.25	16.25

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50% at New York warehouses. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅞-in. dia., 35c.; ¾-in., dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Structural rivets, ½, ⅝, 1 in. diameter by 2½ in. to 4½ in. sell as follows per 100 lb.:

New York ..... $5.00* Chicago ..... $3.50 Pittsburgh ... $2.50@2.60

Boiler rivets, same sizes:

New York ..... $5.20* Chicago ..... $3.70 Pittsburgh $2.90

* For immediate delivery from warehouse.

REFRACTORIES—Prices in carlots f.o.b. plant:

Chrome brick, eastern shipping points	net ton	$48@53
Chrome cement, 40@50% Cr_2O_3, in bulk	net ton	23@28
Chrome cement, 40@50% Cr_2O_3, in sacks	net ton	27@32
Magnesite brick: 9-in. straights	net ton	65@68
Magnesite brick: 9-in. arches, wedges and keys	net ton	71.50@74.80
Magnesite brick: Soaps and splits	per ton	91.00@95.20
Silica brick: Mt. Union, Pa.	per M	38@40
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	40@47
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@45
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	48@50
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	33@40
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	40@43
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	40@43
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	43@45
Chrome ore crude, 40@50%	net ton	19.00@20.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	81.62½
Commercial genuine, intermediate grade	56.00
Anti-friction metal, general service	31.50
No. 4 babitt (f.o.b.)	14.00

COLD DRAWN STEEL—Warehouse prices are as follows:

	New York	Cleveland	Chicago
Round shafting and screw stock, per 100 lb. base	$4.00	$3.90	$3.60
Flats and squares, per 100 lb. base	4.50	4.40	4.10

BOILER SPECIALTIES—F. o. b. New York or Jersey City, discounts on list:

	Current
Copper ferrules	70%
Boiler flanges	60-10%
Boiler stay bolts	60%
Boiler patch bolts	10%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are prices in New York warehouse of tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17 07
1¼	.....	.....	19 20
1½	.....	$38 00	17 92
1¾	.....	28 50	20 48
2	$17 33	25 00	20 24
2¼	19 84	28 25	23 00
2½	21 60	34 00	26 03
3	25 50	42 50	27 04
3¼	30.25	49 50	30 67
3½	31.50	52 75	33 33
4	38.03	67.00	40.11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.

These prices are net per 100 ft. based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller, 5c. per cut. 3 in., 9c. per cut
2¼ and 2½ in., 6c. per cut. 3½ to 4 in., 10c. per cut

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft
No. 14 solid	$33.50 (net)	$ 51 00 (net)	$164.00	$210.00
No. 12 solid	135.00	170.00	225.00	265.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	285.00	375.00	520.00	500.00
No. 6 stranded	400.00	500.00	560.00	.....

From the above lists discounts are:

		Lead Covered
Less than coil lots	50%	20%
Coils to 1,000 ft.	60%	30%
1,000 to 5,000 ft.	60–5%	35%
5,000 ft. and over	60–10%	38%

CONDUIT, Price per 1,000 ft.: **ELBOWS AND COUPLINGS**, Per 100 pieces, f.o.b. New York, with 10-day discount of 5 per cent.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
⅜	72.07	78.63	10.21	11.62	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224 85	245.94	50 13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508 50	218.74	246 10	41.59	45.01
3½	585.30	637.74	483.04	543.46	55.46	60.02
4	714 17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices each in standard-package quantities:

CUT-OUTS, PLUG, SOLID NEUTRAL OR 2 FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID NEUTRAL OR 2 FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$21.50
No. 16 cotton reinforced heavy		25.00
No. 18 cotton reinforced light		17.50
No. 16 cotton reinforced light		21.00
No. 18 cotton Canvasite cord		17.25
No. 16 cotton Canvasite cord		21.00
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$92.00	*101.20
No. 14 super service cord or similar (2 wire) in 1,000 ft.	133.00	*146.40

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.15	3-amp. to 30-amp.	100	$0.30
35-amp. to 60-amp.	100	.30	35-amp. to 60-amp.	100	.60
61-amp. to 100 amp.	50	.90	65-amp. to 100-amp.	50	1.50
101-amp. to 200-amp.	25	2.00	110-amp. to 200-amp.	25	2.50
201-amp. to 400-amp.	25	3.60	225-amp. to 400-amp.	25	5.50
401-amp. to 600-amp.	10	5.50	450-amp. to 600-amp.	10	8.00

Discount: Less 1-5th standard package, 60%; 1-5th to standard package, 65%; standard package, 70%.

RENEWABLE FUSES, ENCLOSED—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4 00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1
450 to 600-amp.	11.00	16.00	10	1

REFILLS—

1 to 30	$0.30 ea.	$0.05	100	100
35 to 60	.05 ea.	.06	100	100
65 to 100	.10 ea.	.10	50	50
110 to 200	.15 ea.	.15	25	50
225 to 400	.30 ea.	.30	25	25
450 to 600	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton	5%
Unbroken carton but less than std. pkg.	22%
Std. pkg.	40%
Discount Without Contract—Renewals:	
Less than std. pkg.	Net list
Standard package	40%
Discount With Contract—Fuses:	
Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%
Discount With Contract—Renewals:	
Less standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP OR CLEARSITT—

0-30 ampere, standard package (500)	$2.85
0-30 ampere, less than standard package	3.15

LAMPS—Below are present quotations in less than standard package quantities:

Straight-Side Bulbs — Mazda B— Watts	Plain	Frosted	No. in Package	Pear-Shaped Bulbs or Bowl Enameled Mazda C— Watts	Clear	Frosted	No in Package
10	$0.27	$0.32	120	50	$0.40	$0.45	60
15	.27	.32	120	75	45	.55	60
25	.27	.32	120	100	.50	.55	24
40	.27	.32	120	150	.65	.70	24
50	.27	.32	120	200	.80	.85	24
60	.32	.37	120	300	1 25	1.35	24
				500	2 00	2.15	12
				750	3.50	3.70	8
				1,000	3.75	3.95	8

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain separable attachment plug	$0 18
Composition 2-piece attachment plug	.27
Swivel attachment plug	.12
Small size—2 Pc. Plug—Composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Duplex
14	$6.70	$9.75	$11.60	$18.20
12	10.10	12.60	14.60	23.80
10	13.20	16.40	18 60	30.50
8	19.00	22.30	24 20	42.40
6	.....	.....	34 40	....
4	.....	.....	48 00	.....
2	.....	.....	68 75	.....
1	.....	.....	94 70	.....
0	.....	.....	115 00	.....
00	.....	.....	138 00	.....
000	.....	.....	165 00	.....
0000	.....	.....	196 00	.....

SOCKETS, BRASS SHELL—

⅛ In. or Pendant Cap — Key Each	Keyless Each	Pull Each	⅜ In. Cap — Key Each	Keyless Each	Pull Each
$0.36	$0.33	$0.50*	$0.42	$0.39	$0.56*

Less 1-5th standard package	30%
1-5th to standard package	40%
Standard package	45%

* Net.

WIRING SUPPLIES—

Friction tape, ¾ in., less 100 lb. 35c. lb., 100 lb. lots	33c lb.
Rubber tape, ¾ in., less 100 lb. 37c. lb., 100 lb. lots	35c lb.
Wire solder, less 100 lb. 29c lb., 100 lb. lots	31c. lb.
Soldering paste, 2 oz. cans	$1.00 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole, Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25 to $50 list value	30–5%
$50 list value or over	35%